



Valero Energy Ltd

**Noise and Vibration Impact
Assessment – Cogen Project**
Doc Ref: Cogen/DNS/Noise/B01

Final for Submission

June 2017

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Prepared by: Jamie Hogg

Technical review: Steve Mitchell

For and on behalf of
Environmental Resources Management

Approved by: Geraint Bowden

Signed: 

Position: Partner

Date: 12/06/17

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EXECUTIVE SUMMARY

A noise and vibration impact assessment was conducted following recognised guidance to consider the potential for significant effects from noise during construction, commissioning and operation. Operational noise effects at residential dwellings in Rhoscrowther, at Eastington Farm and in Angle have been assessed according to BS 4142 ⁽¹⁾ whilst potential noise effects on users of the Pembrokeshire Coast National Park have been considered with reference to BS 8233 ⁽²⁾. Noise from temporary activities has been assessed using the guidance in BS 5228 ⁽³⁾. Vibration was scoped out of the assessment due to the distance from sensitive receptors and the low likelihood of effects.

Baseline noise monitoring was carried out during February, early March and late April 2017 to quantify the noise environment around the application site and to inform the noise assessment. Noise levels were continuously logged for at least two weeks at three residential receptor locations.

Following the application of standard mitigation and management measures for controlling construction noise, the assessment concludes that no exceedances of the assessment criteria are predicted at any noise sensitive receptor (NSR). Therefore, no significant noise impacts are expected during construction. The potential for significant impacts as a result of construction traffic were assessed and these impacts are not expected.

During testing and commissioning of the Project, certain activities have the potential to generate noise off-site over a period of approximately two weeks. These activities will be scheduled to take place during the day or evening, however in the event of unforeseen delays to scheduled daily activities commissioning may need to extend into the night. Local residents will be kept informed of planned potentially noisy commissioning activities, through the Project's and Valero's ongoing stakeholder engagement process. As commissioning activities are expected to be noisy only briefly, and take place during the night only occasionally, adverse effects are not considered significant.

Extensive noise minimisation measures have been included in the Project design to reduce noise at source during operation. For example, the combustion turbine generator (CTG) will include a number of bespoke measures, including enhanced acoustic enclosures. At Rhoscrowther, a difference of up to 6-7 dB between the representative background sound level and the level of plant noise is predicted. As background noise levels are often higher than the representative background sound level, this difference is normally less than 5 dB (the threshold for an adverse impact). Additionally,

(1) BS 4142:2014 Methods for Rating and Assessing Industrial and Commercial Sound, British Standards Institute.

(2) BS8233: 2014, Guidance on Sound Insulation and Noise Reduction for Buildings, BSI, 2014.

(3) BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites', BSI, 2014

by the time the Project is operational, there will be just one occupied residential property in Rhoscrowther (compared to two currently). Taking account of the context of this single property, noise effects from the Project are not expected to be significant.

At Eastington Farm, a difference of up to 2 dB between the representative background sound level and the level of plant noise is predicted. Taking account of the context, noise from the Project at this single property is not expected to result in an adverse effect.

At Angle, a difference of up to (minus) -8 dB between the representative background sound level and the rating level is predicted. Noise from the Project at this location is not expected to result in an adverse effect.

Lower noise levels than those predicted at Rhoscrowther, which are not expected to result any significant effects, are predicted at other properties further away from the Project than Rhoscrowther. Noise from the Project at Pembrokeshire Coast National Park is predicted to be considerably below guideline levels and whilst it may be perceptible at times, it is not expected to reduce the tranquillity of this area. It is therefore considered to be not significant.

Cumulative noise effects as a result of the Project are not expected.

1 INTRODUCTION

1.1 TERMS OF REFERENCE OF THIS REPORT

This report presents an assessment of the likely significant effects due to noise and vibration from the construction and operation of the Valero Cogen project (henceforth the 'Project'). The baseline acoustic environment around the Project site is described, potential effects identified, proposed mitigation measures listed and an assessment of the significance of residual effects is made.

Potential effects of the Project on human noise sensitive receptors (NSRs) include the following:

- noise from construction plant during site preparation and installation of equipment and structures;
- construction traffic on the wider road network;
- noise during commissioning of the facility; and
- 24 hour, year round operation of the facility.

Vibration during construction is not considered further in this assessment because the major construction plant will be over 100 m from the nearest NSR and significant vibration effects are therefore not expected. Vibration during operation is not considered further in this assessment as significant levels of vibration from the Project are not expected to occur.

1.2 BASIS OF ASSESSMENT INCLUDING REALISTIC WORST CASE SCENARIO

1.2.1 Construction

Construction plant items have not been specified in detail at this stage, and only approximate numbers of construction items are available. The locations at which the plant will operate have also not been established. Therefore, the assessment is based on an even spread of construction noise sources around the site. No mitigation has been assumed for construction plant in the predictions.

1.2.2 Construction Traffic

Road traffic flows have been forecast during construction and are reported in the Transport Assessment report. It is expected that the traffic flows to and from the site will vary during the construction period based on experience of similar projects. As reported in the Transport Assessment, at the peak in construction, an additional 66-73 light vehicle trips per day are expected. At its

peak, construction will generate approximately 8 two way Heavy Goods Vehicle (HGV) trips per day.

The increase in road traffic noise created by these flows is assessed in this report.

1.2.3 *Plant Commissioning Assumptions*

Certain activities carried out during commissioning are likely to generate significant noise levels briefly. Commissioning activities will be scheduled to take place during the day or evening, however in the event of unforeseen delays to scheduled daily activities, commissioning may need to extend into the night.

1.2.4 *Plant Operating Assumptions*

The proposed plant has the potential to increase noise levels at residential properties nearby and therefore the potential to create significant noise effects. The extent of the noise increases depends not only on the levels of noise emitted by the plant but also on the baseline noise conditions at the time of operation. The baseline was measured in February and early March 2017 as part of this assessment. Further noise monitoring was carried out to inform the baseline assessment in April 2017.

Noise levels have been predicted based on a preliminary plant design, as discussed in *Section 4*. In common with the Refinery, all plant components are assumed to operate 24 hours a day.

It is envisaged that no additional members of staff will be required to operate the Project over those already working at the Refinery. Therefore no increase in traffic flows and hence no increase in traffic noise is expected.

1.3 *CONSULTATION*

Valero has carried out various consultation activities as part of this application.

Consultation to date on the topic of noise and vibration has included discussions with Pembrokeshire County Council (PCC) and Natural Resources Wales (NRW) on noise sensitive receptors (NSRs) and the scope of the baseline noise survey and assessment methodologies. Responses to the Scoping Report and the EIA Screening Direction Request are presented in *Table 1.1* which also indicates how they have been addressed in this assessment.

Table 1.1 *Scoping Report Comments on Noise and Vibration*

Consultee Comment	Response
<p>Natural Resources Wales commented on the EIA Screening Direction Request as follows:</p> <p>Any application will need to include noise assessments for those receptors around the development, including those receptors across the development in Angle as noise will travel across Angle Bay with very little, or no noise attenuation.</p>	<p>Noise sensitive receptors around the site and in Angle have been chosen to inform an assessment of noise effects from the Proposed Development.</p>

2.1 PLANNING POLICY

2.1.1 Technical Advice Note (TAN) 11

Technical Advice Note (TAN) 11⁽¹⁾ provides guidance to local authorities on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business. It outlines some of the main considerations which local planning authorities should take into account when determining planning applications for development which will either generate noise or be exposed to existing noise sources. TAN 11 also makes reference to guidance and criteria applicable to sources of noise such as industrial and commercial developments, roads and railways.

TAN 11 states that BS 4142 (1997)⁽²⁾ is the most appropriate methodology to assess noise from industrial and commercial developments. This British Standard has since been updated in 2014. The local authority has confirmed that the assessment should be based on the current standard.

2.1.2 BS4142 Methods for Rating and Assessing Industrial and Commercial Sound

The guidance used for the assessment of sound of an industrial and/or commercial nature is *BS 4142:2014 Methods for Rating and Assessing Industrial and Commercial Sound, British Standards Institute*. The current version of the standard is applicable to investigating complaints; assessing sound from proposed, new, modified or additional sources of sound and for assessing sound at proposed new dwellings or premises used for residential purposes.

The methods described in BS 4142 use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling used for residential purposes.

The principal terms used in BS 4142 are broadly defined as follows:

- **Ambient Sound** – the overall sound level from all sources.
- **Specific Sound Level**, $L_S = L_{Aeq,Tr}$ – the noise source under consideration.
- **Rating Level**, $L_{Ar,Tr}$ – Residual noise corrected to allow for certain distinctive acoustic features.
- **Residual Sound Level**, $L_r = L_{Aeq,T}$ – the noise remaining when the specific noise is sufficiently suppressed so as not to contribute to the ambient noise level.

(1) Planning Guidance (Wales). Technical Advice Note 11, 1997.

(2) British Standard BS 4142: 1997 'Method for Rating industrial noise affecting mixed residential and industrial areas'

- **Background Sound Level**, $L_{A90,T}$ – the measured L_{90} level of the residual noise.

The method requires the measurement or prediction of equipment or plant noise (Specific Sound Level) plus a correction for its acoustic character. A comparison is then made between the Rating Level and the Background Sound Level in consideration of the following overall guiding assessment values (taken from BS 4142), to provide an understanding of the potential for, and significance of impact(s):

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, it is less likely that the specific sound source will have an adverse impact or a significant adverse impact.
- Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

The Rating Level of the source is the A-weighted L_{eq} taking into consideration the following characteristics of the sound source; tonality, impulsiveness; intermittency, time of occurrence, duration of event, and any other characteristics of the sound source that are likely to be distinctive in the environment.

BS4142 requires an *initial estimate* of the Specific Sound to be carried out which may later be modified by further consideration of the context. The standard differs from the previous (1997) version in several ways, the consideration of context being one of the most important. A series of examples are given in which the initial numerical estimate is interpreted for a given context to arrive at the assessment of significance.

Where the initial estimate of the impact needs to be modified due to the context, the following factors need to be considered:

- the absolute level of sound where background sound levels and rating levels are low;
- where residual sound levels are very high and the residual sound might itself might result in noise impacts;
- the character and level of the residual sound compared to the character and level of the specific sound;
- evidence on likely human response to sound including references given in BS 4142; and

- the sensitivity of the receptor including façade insulation, acoustic ventilation or screening which will secure good acoustic conditions and reduce receptor sensitivity.

As in the previous (1997) version, the current version of BS 4142 makes reference to BS8233 for consideration of absolute (or benchmark) standards for noise which, as indicated in the examples, it recommends for the assessment of impacts when noise levels are low.

2.1.3

BS8233: 2014, Guidance on Sound Insulation and Noise Reduction for Buildings, 2014

Benchmark noise criteria for various building uses are provided in BS 8233 ⁽¹⁾. The British Standard gives guidelines for avoiding disturbance at night which includes 30 dB L_{Aeq} at night between 2300 and 0700 inside residential buildings. The external noise levels that are equivalent to this value are typically 10 to 15 dB higher with windows open so that a reasonable benchmark would vary between 40 and 45 dB L_{Aeq} (free-field 2300-0700 hours). These noise targets, which apply outside a building, are based on preserving good standards for sleep within the building. The night-time criterion does not aim primarily to preserve residential amenity outside the buildings and is less stringent than BS 4142 initial estimate criteria in areas where baseline noise levels are low. BS 8233 recommends the use of BS 4142 for the purposes of assessing noise changes, noting that noise changes should be considered in the context of the absolute levels of noise.

An external criterion of 50 to 55 dB L_{Aeq} (free-field 0700-2300 hours) has been proposed for more typical daytime activities. External areas such as gardens should also meet a desirable level of 50 dB L_{Aeq} where practicable.

(1) BS8233: 2014, Guidance on Sound Insulation and Noise Reduction for Buildings, BSI, 2014.

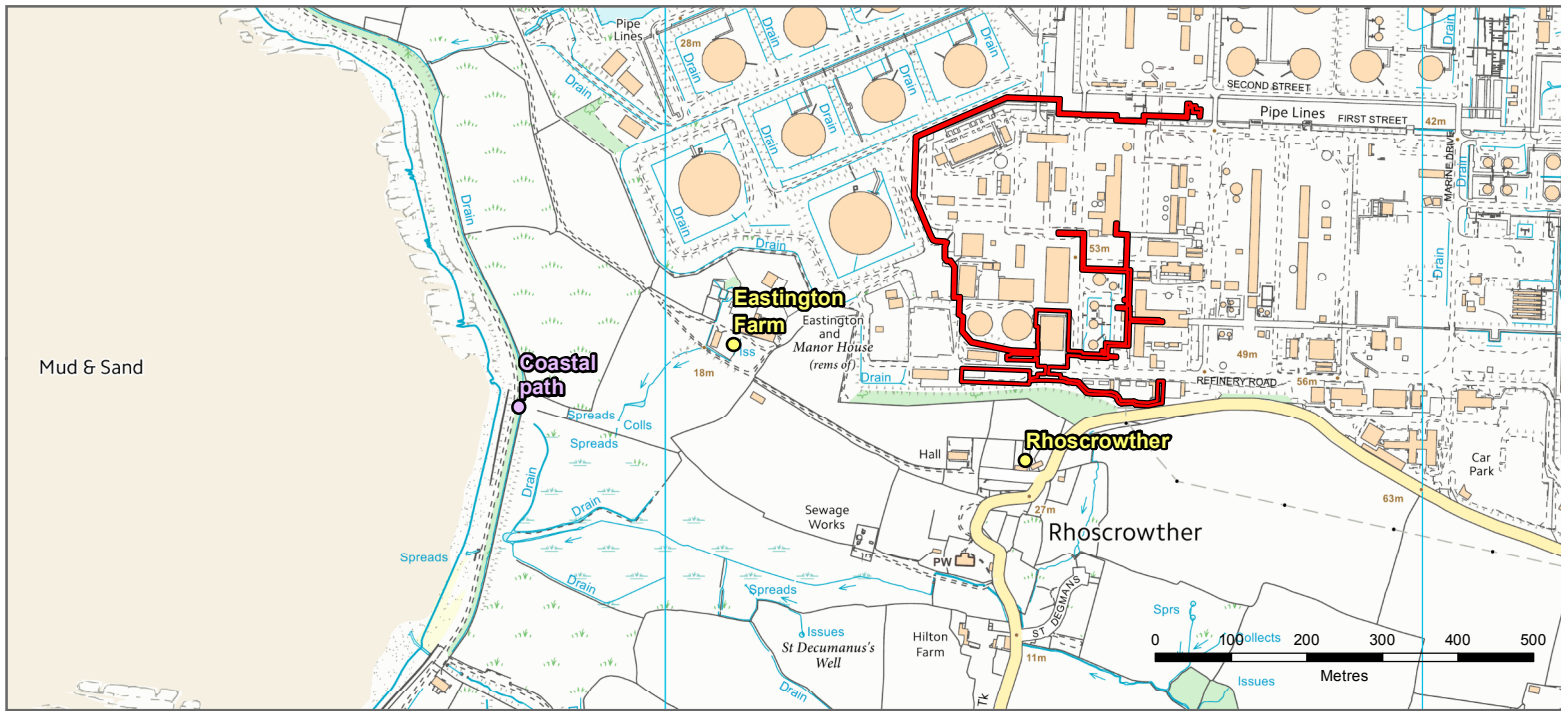
3 *BASELINE CONDITIONS*

3.1 *SUMMARY OF DATA COLLECTED*

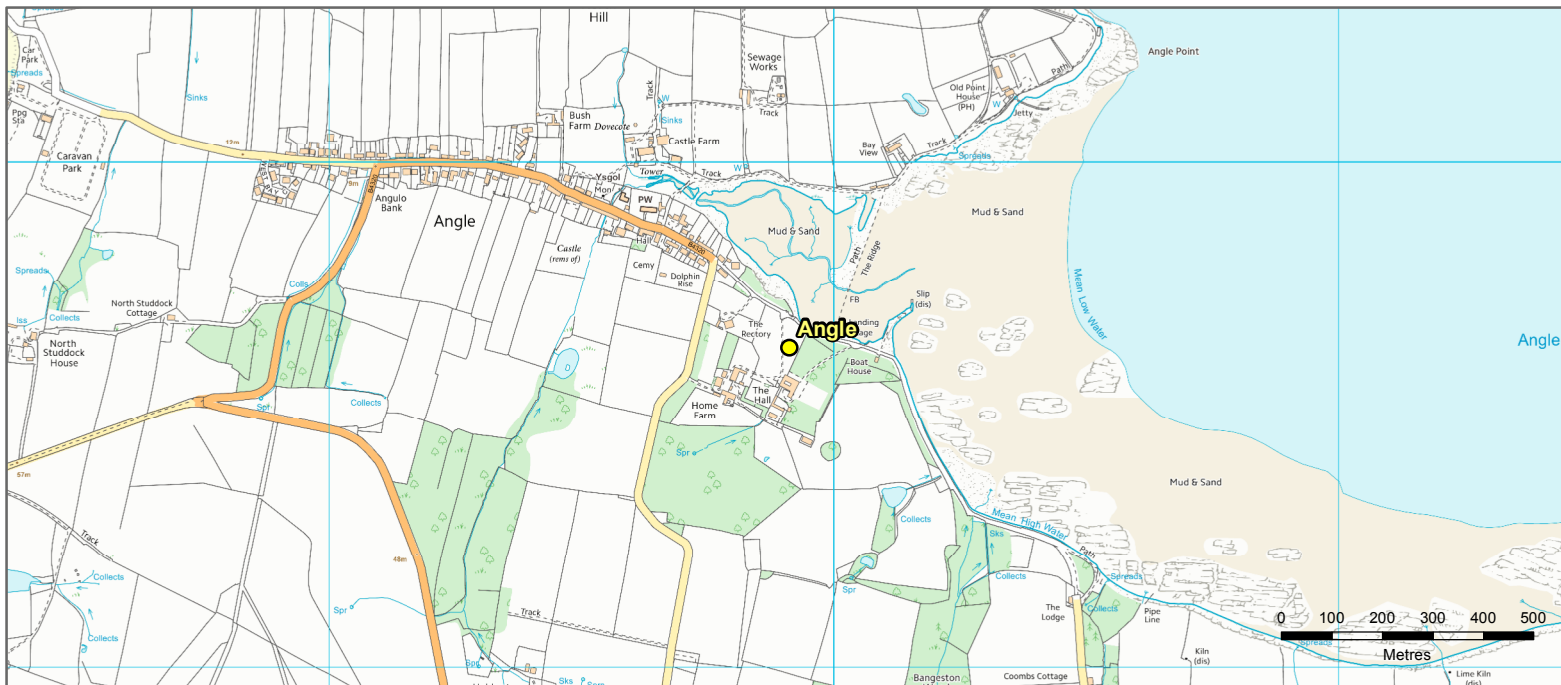
A baseline noise survey was carried out in February, early March and late April 2017 and consisted of a series of continuous unattended noise measurements (UANMs) and operator attended noise measurements (OANMs) within the vicinity of the Project.

Three noise monitoring locations (NMLs) were chosen at NSRs that could be affected by noise from the Project. Long term unattended monitoring was carried out at these locations. In addition, attended measurements were carried out at a further location along the coastal path to quantify the existing noise environment and inform an assessment of the potential change in noise.

The UANM and OANM sites are shown in Figure 3.1.



- Noise Logging Location / Noise Sensitive Residential Receptor
- Attended Noise Monitoring Location
- Project Redline Boundary



SCALE: See Scale Bar

SIZE: A4

PROJECT: 0359804

DATE: 02/05/2017

VERSION: A02

DRAWN: WB

CHECKED: JH

APPROVED: HB

**Figure 3.1
Noise Monitoring Locations and Sensitive Receptors**



PROJECTION: British National Grid

During the survey, meteorological data were measured at the Refinery for the purpose of excluding noise measurements affected by periods of high winds (greater than 5 m/s) and/or rain.

Further monitoring was carried out in Rhoscrowther in April 2017. During this survey, monitoring was carried out simultaneously at Rhoscrowther Village Hall (in the same location as the February / March baseline noise survey) and the back garden of 4 Pleasant View. 4 Pleasant View is closer to residential properties in Rhoscrowther than the Village Hall and is therefore considered to be more representative of the baseline noise environment experienced by residents of Rhoscrowther. The results of this monitoring, which showed noise levels at 4 Pleasant View were approximately 4 dB higher than at the Village Hall, have been used to adjust the levels measured during the February / March baseline noise survey at Rhoscrowther Village Hall.

Details of the survey method and results are provided in *Annex A*.

3.2 *DISCUSSION OF DATA*

In order to follow the assessment guidance in BS 4142, 2014 the representative background sound level is taken to be the background sound level that is typical and most commonly occurring in each time period; day and night. To establish a representative background sound level for each NSR, the method from Section 8 of BS 4142 has been used. The unattended noise monitoring results for each receptor were divided into day (0700-2300 hours) and night (2300-0700 hours) periods, and measurements during bad weather were excluded. Monitoring was carried out for approximately 4 weeks at Eastington Farm and Angle, resulting in approximately 1,200 15 minutes samples. Monitoring was carried out for approximately 4 weeks at Rhoscrowther, resulting in 462 15-minutes samples. The representative background sound level obtained from the BS4142 methodology are summarised in *Table 3.1*. Average sound level, L_{Aeq} , measurements have been calculated over the day and night periods. The range of period values is then reported in *Table 3.1*.

Table 3.1 *Summary of Representative Sound Levels at NSRs*

Monitoring Location	Representative Background Sound Level, $L_{A90,15mins}$		Range of Average Sound Levels, $L_{Aeq,period}$		Description of Noise Environment
	Day	Night	Day	Night	
Rhoscrowther ⁽¹⁾	46	45	51 - 55	46 - 55	Equipment within the refinery.
Eastington Farm	36	35	43 - 49	36 - 50	Bird song and the distant sound of noise from the refinery

Monitoring Location	Representative Background Sound Level, $L_{A90,15mins}$		Range of Average Sound Levels, $L_{Aeq,period}$		Description of Noise Environment
Angle	36	34	40 - 45	30 - 42	Trees / vegetation rustling, bird song.

(1) Values include an adjustment to take account of the difference between noise levels measured at the Village Hall and 4 Pleasant View (see Section 1.3.2 of Annex A for details).

The noise climate at each NSR is discussed briefly below. Further details are provided in *Appendix A*.

3.2.1 *Baseline Limitations*

The baseline survey was carried out during the winter months only. Consequently Baseline noise levels during the warmer months and their effect on noise from the Refinery (e.g. cooling equipment) are not known, but it is likely that any additional cooling equipment would increase baseline noise levels.

3.2.2 *Rhoscrowther*

The noise environment in Rhoscrowther is dominated by noise from the neighbouring Refinery. It is therefore industrial in character. Residual noise levels are relatively high, above the BS 8233 sleep disturbance standard of 40 – 45 dB(A) which assumes that windows are open at night. During the daytime, they are close to the standard of 50 - 55 dB(A) for external amenity areas.

Wind direction influenced measured levels, with lower noise levels measured during prevailing south-westerly winds (when NSRs are upwind of the Refinery). This is discussed further in *Appendix A*. The representative background sound level in *Table 3.1* above is based on the modal value recorded during the survey, which was measured predominantly when the wind was from this prevailing direction. However, significantly higher noise levels were measured at other times, resulting in second distinct ‘peak’ in the distribution of measured background noise levels (at 50 dB during the day and 52 dB at night, $L_{A90,15minutes}$). Background noise levels, $L_{A90,15minutes}$, were 48 dB(A) or above for approximately half of the valid measured samples.

3.2.3 *Eastington Farm*

During daytime visits to this monitoring location, the noise environment at Eastington Farm contained noise from a number of sources, including bird song, and noise from the Refinery, although at a lower level than at Rhoscrowther. Distant farm machinery could also be heard to the south.

During the day, average sound levels, $L_{Aeq,T}$ ranged between 43 dB and 49 dB, normally being between approximately 43 dB and 46 dB. During the night,

sound levels, $L_{Aeq,T}$ ranged between 36 dB and 50 dB and were normally close to 40 dB.

3.2.4 *Angle*

The noise environment at Angle is characterised by bird song, the slight noise of wind in the trees and occasional noises from human activity and boat engines in the nearby bay.

During the day, average sound levels, $L_{Aeq,T}$ ranged between 40 dB and 45 dB and were normally close to 42 dB. During the night, sound levels, $L_{Aeq,T}$ ranged between 30 dB and 42 dB and were normally close to 35 dB.

3.2.5 *Pembrokeshire Coast National Park*

The noise environment on the coastal path as it passes the Refinery is characterised by distant noise from the Refinery, the sound of water in the bay, occasional bird calls, occasional distant noise from a firing range approximately 1 km to the south and occasional cars passing along the path at low speed. During the measurement period, the water in the bay was calm, and the tide receded during the measurement so that the sounds of water could not be heard towards the end of the measurement period.

An average sound level, $L_{Aeq,1hour}$ of 48 dB was measured with a background sound level, L_{A90} , of 33 dB. The average sound level was dominated by noise from the passing cars which was not reflected in the background sound level.

4.1 CONSTRUCTION NOISE ASSESSMENT METHODOLOGY

Construction noise has been predicted based on an understanding from other similar projects of the types and numbers of construction plant that will be used. For the purpose of noise assessment, the construction work has been divided into four main phases:

- site preparation (including concrete breaking);
- earthworks;
- foundations; and
- superstructures and installation.

Sound power levels were calculated to be 125 dB, 116 dB, 114 dB and 113dB respectively for each of the above phases. The plant during these phases has been predicted as being evenly distributed around the Cogen site area which is realistic for this type of construction.

Noise levels have been predicted using the methods set out in British Standard 5228 ⁽¹⁾. This standard provides guidance on construction plant noise levels and on the threshold of significant noise effects on dwellings. Predicted noise levels are compared with the noise criteria in *Table 4.1*. In this case ambient noise levels mean that the NSRs are all Category A, except during the night at Rhoscrowther, where ambient noise levels indicate Category C.

(1) BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites', BSI, 2014

Table 4.1 *Threshold of Significant Effects of Construction Noise at Dwellings*

Threshold of Significant Effect of Construction Noise at Dwellings	Threshold Value, dB		
	Category A ^(a)	Category B ^(b)	Category C ^(c)
Night-time (23.00 – 07.00)	45	50	55
Evenings and weekends ^(d)	55	60	65
Daytime (07.00 – 19.00) and Saturdays (07.00 – 13.00)	65	70	75

Note 1: All sound levels are defined at the façade of the receptor.

Note 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.

Note 3:

- Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
- Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.
- Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than the category A values.
- 19.00 – 23.00 weekdays, 13.00 – 23.00 Saturdays and 07.00 – 23.00 Sundays.

4.2 CONSTRUCTION TRAFFIC NOISE METHODOLOGY

Changes in road traffic noise levels resulting from the construction of the Project are calculated using the Calculation of Road Traffic Noise (CRTN) methodology. Noise changes of greater than 3 dB(A) will be identified as a significant effect. This corresponds to the smallest change in environmental noise that is noticeable under normal conditions.

In cases where the existing traffic noise is very low, the absolute levels of noise are also taken into account when establishing significance of road noise effect. The significance of effects will also depend on the duration over which the change will take place.

4.3 METHODOLOGY FOR THE BASELINE SURVEY

A comprehensive baseline noise survey has been carried out, following the guidance in BS 4142 (2014), and reported in *Annex A*.

4.4 OPERATIONAL ASSESSMENT METHODOLOGY

An assessment of operational noise from the Project has been carried out according to the guidance in BS 4142 (2014).

4.4.1

Operational Noise Predictions

Noise from the operation of the Project has been modelled. SoundPLAN (Version 7.4) noise modelling software package has been used to calculate noise levels using the ISO 9613-2 industrial noise propagation algorithms in octave bands. Ground topography as well as the main buildings close to the Project site have been included in the model.

The modelling is based on preliminary vendor data. Details of the data and assumptions included in the noise modelling are set out in *Annex B*.

Table 4.2 provides a list of the all the equipment as being potentially significant sources of noise. The right hand column of *Table 4.2* provides, for each item of equipment, details of the data and assumptions included in the noise model or refers to separate table of details.

Table 4.2 *Potentially Noisy Equipment*

Equipment	Details of the data and assumptions included in the noise model
Combustion Turbine Generator (CTG) package	Total sound power: 112 dB(A)
Heat Recovery Steam Generator (HRSG) unit	Total sound power: 91 dB(A)
Air blowing and Steam blowing	These activities are only required during commissioning. At all other times noise from these activities will not be significant ⁽¹⁾ .
<p>1) Not significant in this context means a noise level that does not contribute significantly to, i.e. is at least 20 dB(A) lower than, the overall predicted noise level from the Project at the nearest noise sensitive receptors.</p>	

Initial modelling showed the standard CTG package and the HRSG to be the predominant noise sources. Thus, as part of the design refinement and consultation process, an alternative silencing arrangement has been applied which significantly reduces noise from the HRSG. Data for a low noise CTG package was sought and has been included, also in response to earlier model iterations and consultation feedback. Noise mitigation on the CTG package includes the following:

- high performance acoustic enclosure on the turbine (increased thickness panels than standard);
- longer than normal silencer in the GT inlet duct;
- Noise attenuating skirts for the:
 - GT baseplate; and
 - gearbox and electrical generator baseplate.
- acoustic insulation on the GT inlet duct;
- low noise treatment for the GT inlet filter-house;
- low noise air coolers;

- low noise ventilation fans;
- additional acoustic insulation and silencers for ventilation
- enhanced acoustic enclosure for the electrical generator and gearbox;
- enhanced silencer and section for the generator air cooling; and
- acoustic barriers around GT exhaust expansion joint.

If the plant has tonality or acoustic features the assessment method in BS4142 requires an acoustic feature correction to be added to the predicted noise level from the plant before it is assessed against the criteria. There are a number of steps that will be taken to ensure that noise from the plant will be non-tonal and free of other acoustic features as discussed in *Section 5.6*. Therefore, a correction has not been applied in this assessment because it is most likely that the need for a correction can be avoided during detailed design and commissioning phases of Project development.

5.1 INTRODUCTION

This assessment compares modelled noise levels from the Project with appropriate criteria which are informed by baseline survey work.

5.2 ASSESSMENT OF EFFECTS DURING CONSTRUCTION

The predicted levels of noise during the four main phases of construction activity (Site Preparation/Earthworks / Foundations /Construction) for each NSR are summarised in *Table 5.1*.

Table 5.1 Unmitigated Construction Noise Levels (Facade) and Likely Impacts

NSR	Predicted Noise, LAeq,T		Exceedance of Assessment Criterion, dB	
			Day 65 dB	Evening 55 dB
Rhoscrowther	Site Preparation	72	6	16
	Earthworks	62	0	7
	Foundations	60	0	5
	Superstructures	59	0	4
Eastington Farm	Site Preparation	60	0	5
	Earthworks	50	0	0
	Foundations	48	0	0
	Superstructures	47	0	0
Angle	Site Preparation	46	0	0
	Earthworks	36	0	0
	Foundations	34	0	0
	Superstructures	33	0	0

No significant construction impacts are predicted at Angle. At Eastington Farm, significant impacts are predicted only during the evening whilst site preparation works are taking place.

At Rhoscrowther, exceedances of the criteria are predicted during the evening during all phases of construction and during the daytime during site preparation works.

Mitigation is discussed below.

5.2.1 Mitigation Measures During Construction

There are various ways to reduce levels of noise emitted from construction sites that can be used if necessary to reduce construction noise; most of these

are standard good practice that would be likely to be adopted anyway for the wellbeing of the workforce. They include the following:

- use of models of compressors, generators and pumps fitted with properly lined and sealed acoustic covers or enclosures, which will be kept closed whenever the machines are in use;
- fitting of mufflers or silencers of the type recommended by manufacturers;
- shutting down of machines in intermittent periods between work, or throttling down to a minimum;
- maintenance of plant in good working condition to minimise extraneous noises arising from mechanical vibration; and
- siting noisy plant and equipment as far away as possible from noise sensitive receptors to reduce the level of construction noise wherever possible.

Through the application of the measures outlined above an overall reduction in construction noise of 5 dB is expected.

Some work may be required in the evening and night. This will be limited to works that are not major sources of noise so that levels at NSRs are kept below the relevant criteria (of $L_{Aeq,period}$ 55dB during the evening (1900-2300hrs) and, at night, a level of $L_{Aeq,period}$ 55dB at Rhoscrowther and a level of $L_{Aeq,period}$ 45dB at all other receptors). Noise levels will be monitored to ensure significant impacts are not created, except in the unusual case that higher levels need to be agreed with the local authority.

5.2.2 *Residual Effects During Construction*

Following the application of the mitigation and management measures outlined above, significant impacts will be limited. This is summarised in *Table 5.2*.

Table 5.2 *Residual Construction Noise Levels (Facade) and Likely Impacts*

NSR	Predicted Noise, $L_{Aeq,T}$		Exceedance of Assessment Criterion, dB	
			Day 65 dB	Evening 55 dB
Rhoscrowther	Site Preparation	67	1	0 ⁽¹⁾
	Earthworks	57	0	0 ⁽¹⁾
	Foundations	55	0	0
	Superstructures	54	0	0
Eastington Farm	Site Preparation	55	0	0
	Earthworks	45	0	0
	Foundations	43	0	0
	Superstructures	42	0	0
Angle	Site Preparation	41	0	0
	Earthworks	31	0	0

NSR	Predicted Noise,		Exceedance of Assessment	
	L _{Aeq,T}		Criterion, dB	
	Foundations	29	0	0
	Superstructures	28	0	0
1) Evening works will be limited to works that are not major sources of noise so that levels at NSRs are kept below L _{Aeq,period} 55dB.				
2) Night time works will be limited to works that are not major sources of noise so that levels at NSRs are kept below a level of L _{Aeq,period} 55dB at Rhoscrowther and a level of L _{Aeq,period} 45dB at all other receptors				

Construction is expected to last approximately one and a half to two years with quieter superstructure and fit out work taking up the larger latter part of this period.

No exceedances of the criteria are predicted at Angle or Eastington Farm. At Rhoscrowther, no exceedances are predicted during the evening. A small exceedance of 1 dB is predicted during the daytime only as a result of concrete breaking during site preparation works. If site hoardings are not sufficient to reduce noise from this activity to below the criterion, other measures will also be employed to reduce noise.

Therefore, no significant noise impacts are expected during construction.

5.2.3

Construction Traffic

At its peak, it is envisaged that construction will attract around 200 - 220 construction staff. Based upon typical levels of vehicle sharing (three workers per vehicle) construction is predicted to result in 66-73 additional trips during peak hours. At its peak, construction will generate approximately 8 two way Heavy Goods Vehicle (HGV) trips per day.

Abnormal loads are expected to arrive via the heavy lift wharf. This is an existing dedicated marine import facility adjacent to the fuel import/export jetty. As this is not expected to significantly increase vessel activity in the estuary, significant noise effects are not expected and have been scoped out.

In order to result in a 3 dB increase in traffic noise, which would be identified as a significant impact, construction traffic would need to approximately double current traffic flows. There are currently around 700 staff on site on an average weekday, with around 430 vehicles using the on-site car park and a further 250 vehicles (including couriers and deliveries) accessing the site on a daily basis. There are approximately 81 existing HGV movements associated with the operation of the Refinery on an average weekday. Although some staff currently work outside of normal shift hours so that not all of the 430 cars using the car park arrive in the same peak hours, the majority do and therefore construction traffic is not expected to result in a doubling of traffic to the site. The number of HGVs expected during the construction phase is small compared to the number which currently accesses the Refinery on a daily basis.

Therefore, significant impacts as a result of construction traffic are not expected.

5.3 *ASSESSMENT OF CUMULATIVE EFFECTS DURING CONSTRUCTION*

Western Power Distribution (WPD) are proposing to provide an electrical connection to the new 132kV meter skid within the Refinery. Construction will take place during construction of the Project.

A cable would run underground from the meter skid to the existing Refinery electrical connection, running between the Refinery and Rhoscrowther. In addition, an overhead cable will be extended from its existing pole to the east of Rhoscrowther and will join the underground cable at a location north of Pleasant View, in between Rhoscrowther and the Refinery boundary.

The highest noise levels from construction of the Project are expected to be during site preparation. During other construction phases, predicted noise levels are at least 8 dB(A) below the daytime criterion and are therefore unlikely to contribute to significant noise impacts at nearby properties. Should construction of the underground cable trench take place during site preparation works or during the evening, cumulative impacts are possible. However, as trenching works are expected to be relatively short-lived (one or two months), cumulative impacts are not expected to be significant.

5.4 *ASSESSMENT OF EFFECTS DURING COMMISSIONING*

During testing and commissioning of the Project, certain activities have the potential to generate significant levels of noise off-site. These activities are expected to be:

- air blowing; and
- steam blowing.

They would be carried out up to approximately 15 – 20 times per day, for a period of approximately two weeks. Each test will take 15 – 20 minutes.

The abovementioned commissioning activities will be scheduled to take place during the day or evening, however in the event of unforeseen delays to scheduled daily activities commissioning may need to extend into the night.

Only preliminary data are available at this stage, however this suggests that these tests will be higher in level to other process equipment, in the order of 120 dB(A) close to the equipment. Therefore, noise from commissioning activities may be clearly audible at the nearest NSRs; however individual tests will be noisy only briefly.

During commissioning, local residents will be kept informed of planned potentially noisy commissioning activities, through the Project's ongoing stakeholder engagement process.

As commissioning activities are expected to be noisy only briefly, and take place during the night only occasionally, adverse effects are not considered significant.

5.5 ASSESSMENT OF EFFECTS DURING OPERATION

5.5.1 Initial Estimates of Impacts

The criteria used to assess noise impacts are discussed in *Section 2.1*. First an *initial estimate* of the impact is made using the BS 4142 method. Then the context of that estimate is considered for each NSR in turn using the guidance in BS 4142 to determine the effect significance.

Table 5.3 summarises the baseline sound levels, presents predicted noise levels from the Project based on the level of noise mitigation described in *Section 4.4* and presents an initial estimate of impacts at each of the three NSRs. Levels are free-field and at first floor window level. Sound levels from the Project at ground floor level will be slightly lower (due to greater ground absorption and screening from the intervening topography).

Table 5.3 Initial Estimate of Noise Impacts (Free-field, 1st Floor Level)

NSR	Predicted Rating Level, $L_{A,T,r}^{(1)}$	Representative Background Sound Level, $L_{A90,15mins}$		Exceedence of Rating Level over Representative Background Sound Level, dB	
		Day	Night	Day	Night
Rhoscrowther	52 ⁽³⁾	46 ⁽²⁾	45 ⁽²⁾	6	7
Eastington Farm	37	36	35	1	2
Angle	26	36	34	-10	-8

1) An acoustic feature correction has not been applied in this assessment because it is most likely that the need for a correction can be avoided during the detailed design and commissioning phases of Project development.

2) Values include an adjustment to take account of the difference between noise levels measured at the Village Hall and 4 Pleasant View (see *Section 1.3.2 of Annex A* for details).

3) Noise level predicted at the only property (one Pleasant View) that will be occupied once the Project is operational.

As required by BS 4142, the context has been considered at each NSR location.

Rhoscrowther

Table 5.3 shows the exceedance of rating level over background sound level is predicted to be 6 dB during the day and 7 dB at night. The representative background sound level occurs during prevailing south-westerly wind conditions, when measured background sound levels were at their lowest. In practice and based on survey data, background sound levels will often be higher than the representative background sound level. Excluding measurements discarded due to bad weather, for 64% / 58% of the survey period (day / night respectively) the background sound level, L_{A90} , was 47 dB(A) or above, resulting in an exceedance of rating level of 5 dB or less, ie at or below the threshold for an adverse impact.

There are currently only two occupied dwellings in Rhoscrowther. An agreement has been reached with the owner of the property on Pleasant View for Valero to purchase their property. Valero does not intend to let or use the purchased property for residential purposes. Therefore, by the time the Project is operational, there will be just one occupied residential property in Rhoscrowther (No. 1 Pleasant View).

Noise from the Project would have an industrial character, which would be in common with the existing noise environment. This should lessen its perceived impact as it will sit within a context largely characterised by an industrial noise soundscape.

During the night-time people are generally indoors. Therefore the external noise level is less important than the internal noise level. As the existing noise level in Rhoscrowther is relatively high, it is likely that the occupiers of the one occupied residential property will have made adjustments for any elevated internal noise levels.

The representative background sound level occurs largely when receivers are upwind of the Refinery, due to the prevailing wind direction. The predicted noise modelled for the Project, however, assumes receptors are downwind (using the ISO 9613-2 method). This results in a conservative estimation of the actual likely level of noise impact.

The main garden of No. 1 Pleasant View, the one remaining occupied property, is situated to the south of the house and slopes away from the Project. As a result, the area directly in front of the house will be screened from Project noise. Noise from the Project has been predicted at a distance of 3 m from the front of the property (and at a height of 1.5 m above ground level), to represent an area that may be used for enjoying the external amenity. Project noise is predicted to be 39 dB, L_{Aeq} , resulting in a good external amenity.

In summary:

- Background sound levels are often higher than the representative background sound level. For more than half of the time the exceedance of rating level over background sound level is predicted to be 5 dB or less, ie at or below the threshold for an adverse impact.
- By the time the Project is operational, there will be just one occupied residential property in Rhoscrowther.
- Noise from the Project would have an industrial character which would be in common with the existing noise environment. This should lessen its perceived impact.
- The representative background sound level occurs largely when receivers are upwind of the Refinery whereas the predicted noise modelled for the Project assumes receptors are downwind. This results in a conservative estimate of the actual likely level of noise impact.
- The main garden of No. 1 Pleasant View is situated to the south of the house. As a result, the area of the garden directly south of the house will be screened from Project noise. It is predicted to be 39 dB, L_{Aeq} , resulting in a good external amenity.

A number of factors are relevant to the context of noise from the Project in Rhoscrowther. Each one suggests the significance of noise effects would be lower than the initial estimate set out in *Table 5.3*. Therefore taken together, the significance of noise effects is expected to be significantly lower. Taking account of the context, noise effects from the Project are not expected to be significant.

Eastington Farm

Noise from the Project is predicted to be within 1 dB during the day and 2 dB at night of the representative background sound level.

BS 4142 states that “A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context” and for differences below this level, it states “The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact.” Therefore, unless there are contextual reasons to the contrary, noise at this level is unlikely to be significant.

New noise from the Project would not be the only form of industrial noise heard at this NSR. This should lessen its perceived impact, which will sit within an industrial noise soundscape.

Noise levels are predicted to be below the guideline values in BS 8233 for outdoor amenity space and below the night-time value of 40 – 45 dB(A) for sleep disturbance.

Taking account of the context, noise from the Project at this single property is not expected to result in an adverse effect.

Angle

Predicted noise from the Project is predicted to be 10 dB and 8 dB below the representative background sound level during the daytime and night-time respectively. BS 4142 states that “Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.”

Noise levels are predicted to be clearly below the guideline values in BS 8233 for outdoor amenity space and below the night-time value of 40 – 45 dB(A) for sleep disturbance.

Noise from the Project at this location is not expected to result in an impact.

5.5.3 Noise Sensitive Receptors Further from the Project

A number of isolated properties are situated further from the development. The closest of these is Little Neath Barn (situated approximately 1.3 km to the south). The predicted noise from the Project at this property is 34 dB(A), $L_{Aeq,T}$. Noise levels are predicted to be lower than this at other properties.

BS 4142 refers to a 2004 paper commissioned by DEFRA ⁽¹⁾ which reviews studies carried out relating industrial noise to annoyance. It includes a review of a 2002 report ⁽²⁾ which documents 11 surveys of annoyance from industrial noise, conducted in the Netherlands, involving about 2000 residents. Analysis of the data was used to generate a curve for Expected Annoyance (EA) (a measure of mean annoyance on the scale 0 – 100), against noise in DENL, dB(A). As the Project will operate continuously 24/7, a predicted level of 34 dB(A), L_{eq} , equates to a DENL of 40 dB(A). The dose response curve does not extend to noise levels below DENL 45 dB(A), however, this level results in an EA value of 10 (out of 100). Therefore, annoyance from a level, DENL, of 40 dB(A) is expected to be minimal, and not significant.

A level of 34 dB(A) does not exceed the BS 8233 standard of 40 – 45 dB(A) for sleep disturbance or the 50 – 55 dB(A) standard for external areas that are used for amenity space.

(1) Review and analysis of published research into the adverse effects of industrial noise, in support of the revision of planning guidance. B.Berry in association with N.Porter. March 2004.

(2) H M E Miedema, R G de Jong et al. 2002. TNO Inro rapport 2002-53 Relaties tussen geluidbelasting en hinder voor industrie- en rangeerterreinen.

A level of 34 dB(A) is considered to be a low level of noise and although it may be noticeable at times, when background levels are low, is not expected to result any significant effects and is therefore considered not significant.

Pembrokeshire Coast National Park

A noise level from the Project of up to 35 dB(A) is predicted at the coastal path.

Existing noise levels were measured here. The background noise level, $L_{90,1hr}$, which excludes intermittent sounds, including the infrequent cars which use the path was 33 dB(A). The average measured baseline noise level, $L_{eq,1hr}$ (including four car passes), was 48 dB(A). Although low in level, the refinery was audible at this location.

Noise from the Project is predicted to be considerably below the BS 8233 guidelines (of 50 - 55 dB, $L_{Aeq,16h}$) for outdoor living areas and whilst it may be perceptible at times, it is not expected to significantly reduce the tranquillity of this area. It is therefore considered to be not significant.

5.6 PREDICTION OF CHARACTER OF ACOUSTIC FEATURES OF PLANT INCLUDING TONALITY

It has been assumed that the plant will not exhibit an acoustic tonal feature and therefore there no correction in that regard has been applied in this analysis.

The way that a number of different sources of noise combine to give the total noise emission of the plant is complex and while equipment suppliers can estimate the likely overall noise or the noise at well-defined octave frequency bands, it is not practical to model tonal noise. The well-established procedures in ISO 9613-2 (1996) ⁽¹⁾ have been used to predict noise propagation, and this method provides a method for calculating industrial noise propagation in octave bands or a simplified dB(A) value. It does not have a tonal prediction procedure.

If any audible tonal noise is observed during testing and/or commissioning it will be analysed to identify the cause and corrective measures will be applied. This approach is typical to the 'commissioning stage' of developments such as this and again would be secured through the contract with the EPC contractor.

5.7 ASSESSMENT OF CUMULATIVE EFFECTS DURING OPERATION

The following projects, which are currently in the planning process, have been considered for their potential to result in significant cumulative noise impacts.

(1) Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation

5.7.1 *Egnedol Biomass Energy Facility*

The proposed project includes a thermal facility for the processing of waste. The site location is approximately 2.9 km from the Project.

The nearest NSRs to the proposed Egnedol facility lie in Milford Haven, approximately 3 km from the Project. Predicted noise from the Project at these NSRs is approximately 29 dB(A). This is not expected to contribute to a significant impact in this urban location.

5.7.2 *South Hook Combined Heat & Power Station*

The proposed project includes an integrated combined heat and power plant based on combined cycle gas turbine technology with an installed capacity of up to 500MWe. The site location is approximately 4.5 km from the Project.

NSRs likely to be most affected by cumulative noise from the two projects are properties in Gelliswick, on the northern side of the estuary in between South Hook and the Project, and properties in Angle, which is situated approximately equidistant from the two projects. Predicted noise from the Project is similar at both locations; approximately 26 dB(A), and is therefore expected to be too low to contribute to a significant impact in either location.

Annex A

Baseline

INTRODUCTION

Baseline noise monitoring was carried out during February, early March and late April 2017 to quantify the noise environment around the application site.

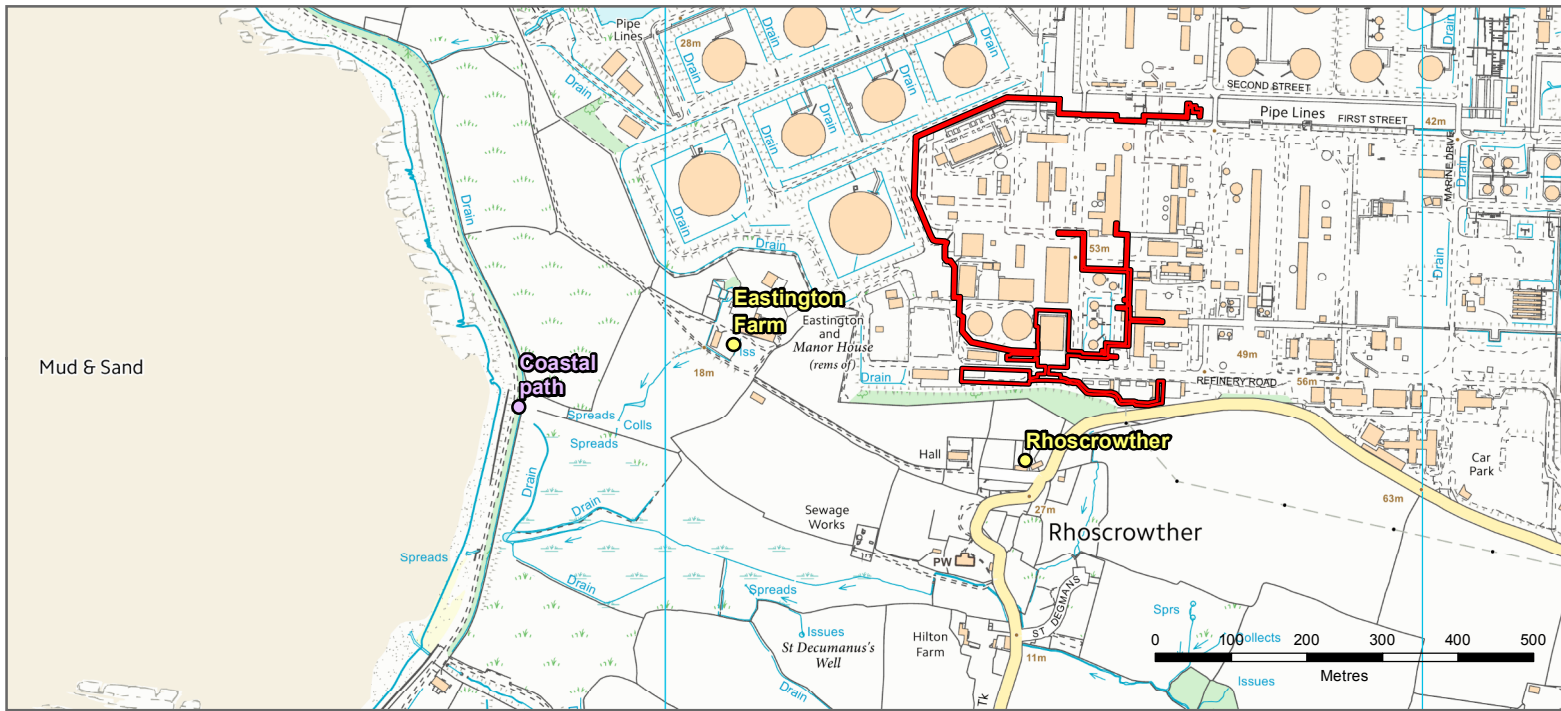
Noise levels were continuously logged for at least 2 weeks at three residential receptor locations in February and early March 2017. The location referred to as noise sensitive receptors (NSRs) were consulted and agreed upon at the 'scoping stage' of the application:

- Rhoscrowther;
- Eastington Farm; and
- Angle.

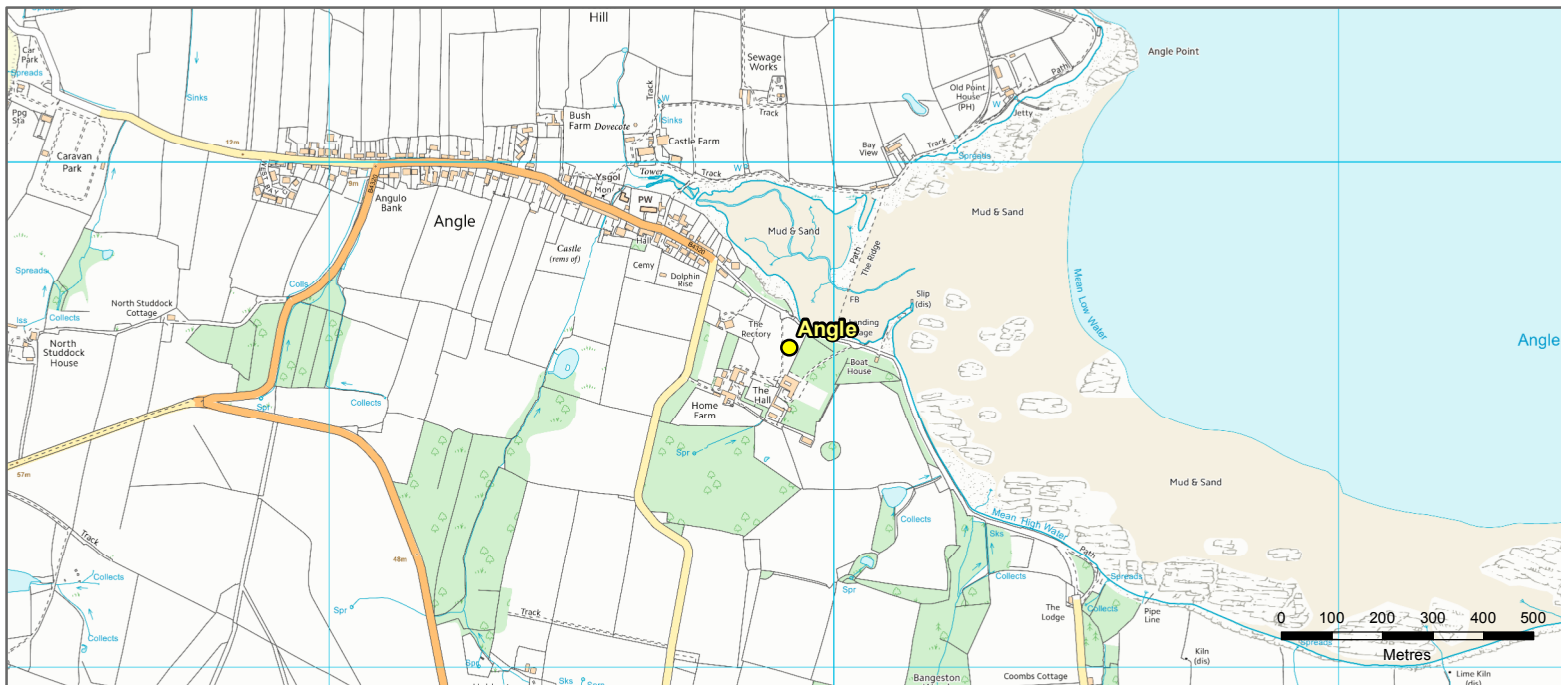
In addition, attended measurements were carried out at a further location along the coastal path to quantify the existing noise environment and inform an assessment of the potential change in noise.

A further noise monitoring survey was carried out in April 2017. This survey compared noise levels in Rhoscrowther at the monitoring location used in the February survey (Rhoscrowther Village Hall), with noise levels at 4 Pleasant View. The measurements were used to adjust the measurements made at the Village Hall in February, as the 4 Pleasant View location is considered to better represent baseline noise levels at residential properties in Rhoscrowther.

Measurement locations are shown in *Figure 1.0*.



- Noise Logging Location / Noise Sensitive Residential Receptor
- Attended Noise Monitoring Location
- Project Redline Boundary



SCALE: See Scale Bar	VERSION: A02
SIZE: A4	DRAWN: WB
PROJECT: 0359804	CHECKED: JH
DATE: 02/05/2017	APPROVED: HB

Figure 1.0
Noise Monitoring Locations and Sensitive Receptors



PROJECTION: British National Grid

1.2

METHOD

Monitoring was carried out using Class 1 sound level meters. The meters were attached to tripods at a height of approximately 1.2 m above the ground. The meters were located in free-field conditions (i.e. at least 3.5 m from hard reflecting surfaces).

All sound level meters were within their calibration period. The sound level meters were calibrated before the survey. The calibration levels were checked at the end of the survey and no significant drift was noted. 15 minute noise levels were logged continuously throughout the survey periods.

1.3

RESULTS

1.3.1

Summary

Table 1.1 summarises the results of the further noise monitoring carried out in Rhoscrowther in April, which showed noise levels at 4 Pleasant View are approximately 4 dB higher than at the Village Hall monitoring location. Table 1.2 summarises the results of the February / March baseline noise surveys, including the derived representative background sound levels.

Table 1.1 *Summary of the Difference in Measured Noise Levels Between the Village Hall and 4 Pleasant View Measurement Locations in Rhoscrowther*

Average (Arithmetic) Difference in Background Sound Level, $L_{A90,15mins}$, dB	Range of Differences in Background Sound Level, $L_{A90,15mins}$, dB	Variability	Average (Arithmetic) Difference in Background Sound Level, $L_{Aeq,15mins}$, dB	Range of Differences in Background Sound Level, $L_{Aeq,15mins}$, dB	Variability
4	2 to 7	5	4 ⁽¹⁾	2 to 6 ^{(1) (2)}	4 ^{(1) (2)}

1) Two periods where larger differences in L_{Aeq} noise levels between Rhoscrowther Village Hall and 4 Pleasant View were noted have been excluded. This is discussed further in Section 1.3.2.
 2) Two extraneous measurements have been excluded.

Table 1.2 *Summary of Baseline Noise Environment*

Monitoring Location	Representative Baseline Sound Level, $L_{A90,15mins}$		Range of Period Average Sound Levels, $L_{Aeq,period}$ ⁽¹⁾		Description of Noise Environment
	Day	Night	Day	Night	
Rhoscrowther ⁽²⁾	46	45	51 - 55	49 - 55	Equipment within the refinery.
Eastington Farm	36	35	43 - 49	36 - 50	Bird song and the distant sound of noise from the refinery
Angle	36	34	40 - 45	30 - 42	Trees / vegetation rustling, bird song.

Monitoring Location	Representative Baseline Sound Level, $L_{A90,15mins}$	Range of Period Average Sound Levels, $L_{Aeq,period}^{(1)}$	Description of Noise Environment
1)	Values exclude days where more than half of the measurements were discarded as a result of adverse weather		
2)	Values include an adjustment to take account of the difference between noise levels measured at the Village Hall and 4 Pleasant View (see Section 1.3.2 for details)		

1.3.2

Rhoscrowther

February / March Baseline Noise Survey

Measurements were carried out at Rhoscrowther Village Hall for approximately two weeks between 17th February and the 2nd March 2017. After discarding those measurements carried out during periods of rain or when wind speeds were above 5 m/s, a total of 302 daytime and 160 night time 15 minute measurements remain.

Figure 1.1 presents the sound levels measured during the survey. *Figures 1.2* and *1.3* show the spread of background sound level values, $L_{A90,15minutes}$, measured during the daytime and night time respectively. *Figures 1.4* and *1.5* show the how often background sound levels occurred during the survey (excluding periods of bad weather).

Table 1.1 presents average period sound levels as well as the range of other noise metrics recorded on each day during the survey.

Figure 1.1 Noise Levels (Free-field) Measured During the Survey at Rhoscrowther (Measurements During Adverse Weather Not Removed)

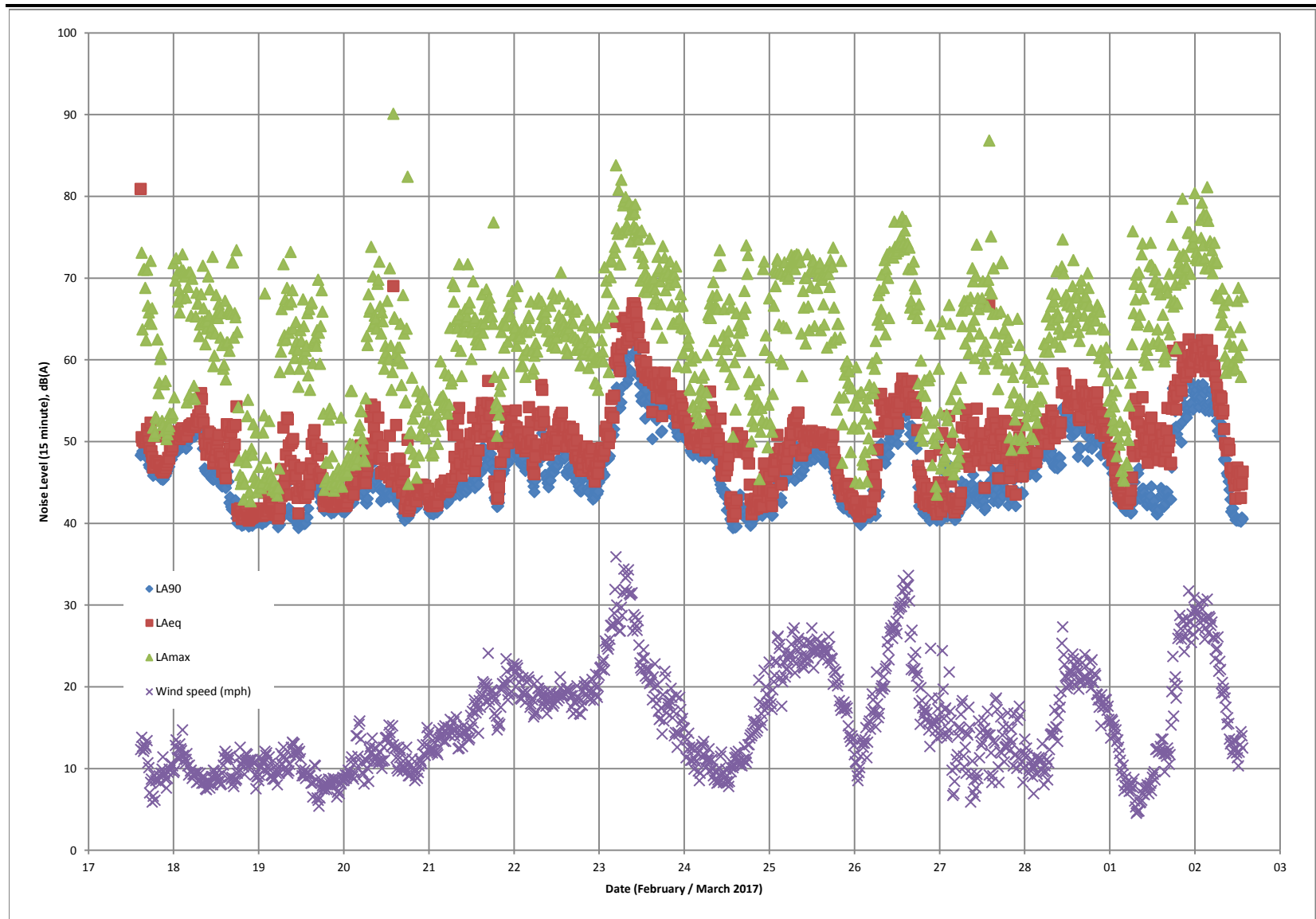


Figure 1.2 *Spread of Background (Free-field) Sound Levels, $L_{A90,15\text{minute}}$, Measured During the Daytime (Measurements During Adverse Weather Have Been Removed)*

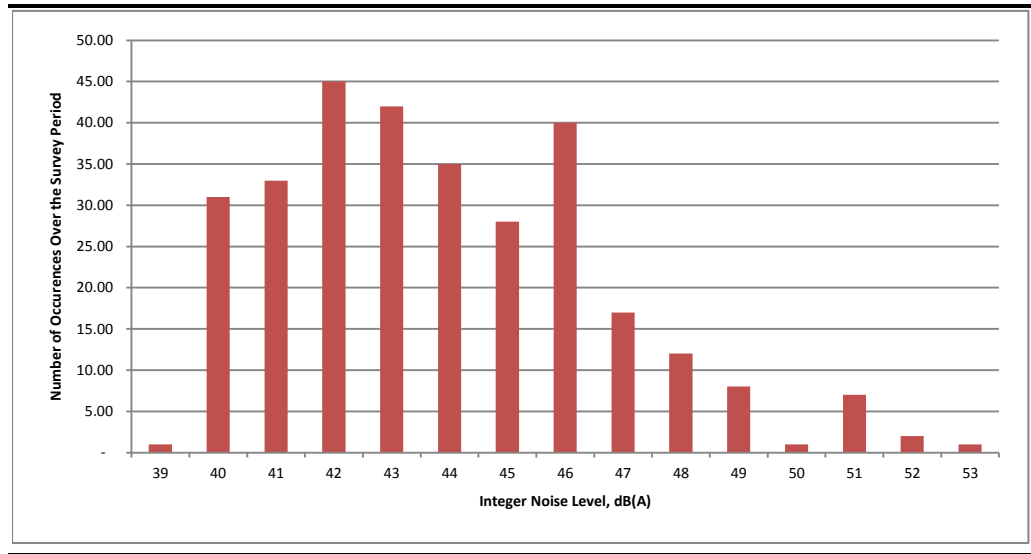


Figure 1.3 *Spread of Background (Free-field) Sound Levels, $L_{A90,15\text{minute}}$, Measured During the Night time (Measurements During Adverse Weather Have Been Removed)*

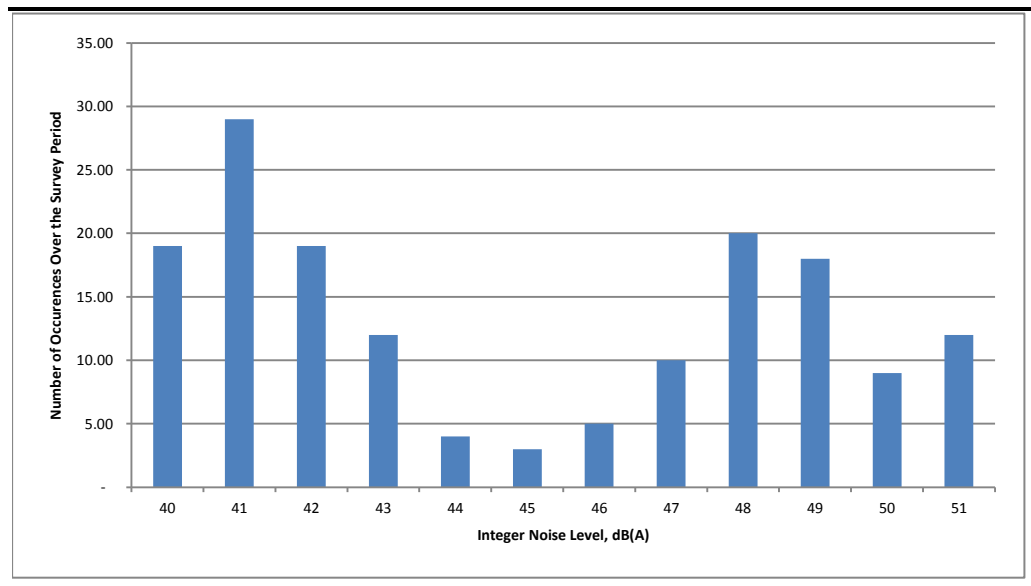


Figure 1.4 *Cumulative Chart Showing Measurement Time Above Background Sound Level During the Day*

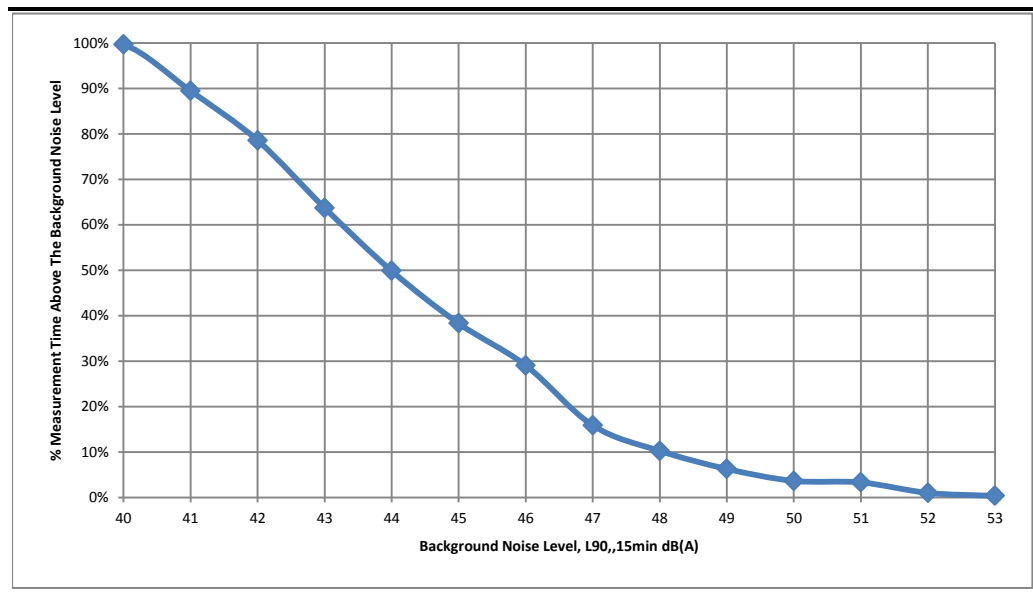


Figure 1.5 *Cumulative Chart Showing Measurement Time Above Background Sound Level During the Night*

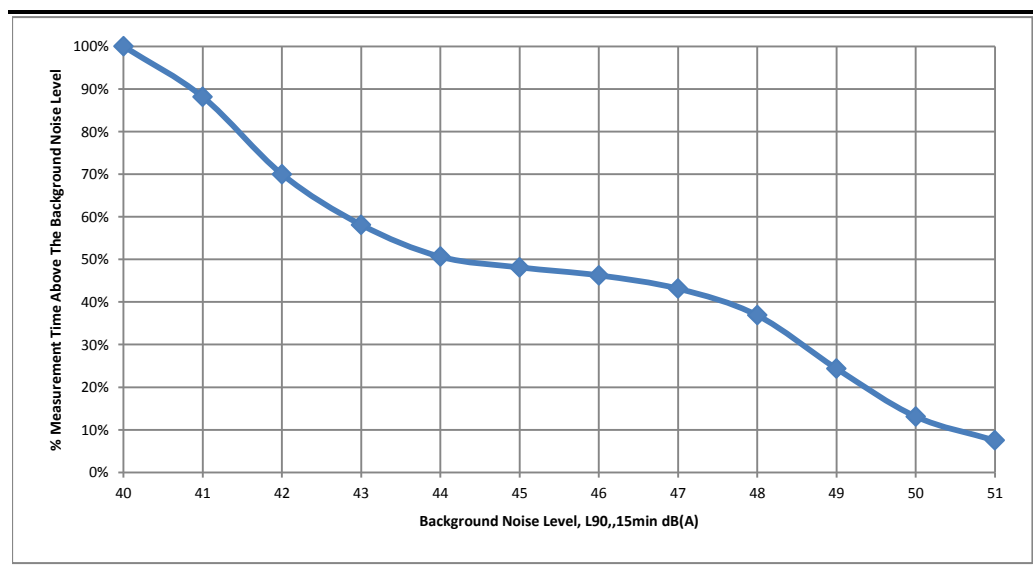


Table 1.3 *Period Sound Levels and Other Noise Metrics (Free-field) Recorded on Each Day of the Survey (Measurements During Adverse Weather Have Been Removed)*

Date	Day/ Night	Measurement Period (hours) (1)	Range of 15 minute measurements, dB				
			L _{Aeq,period}	L _{Aeq}	L _{A10}	L _{A90}	L _{Amax}
17/02/2017	Night	5.5	51	49 - 53	50 - 54	48 - 51	53 - 73
18/02/2017	Day	14.75	49	40 - 56	41 - 58	40 - 53	43 - 73
	Night	7.25	42	41 - 47	42 - 51	40 - 42	43 - 66
19/02/2017	Day	14.0	47	42 - 53	43 - 57	40 - 46	44 - 72

Date	Day/ Night	Measurement Period (hours) (1)	Range of 15 minute measurements, dB				
			L _{Aeq,period}	L _{Aeq}	L _{A10}	L _{A90}	L _{Amax}
20/02/2017	Night	6.0	45	42 - 50	43 - 51	41 - 48	45 - 62
	Day	11.25	48	42 - 55	42 - 58	40 - 49	45 - 82
21/02/2017	Night	0.25	43	43 - 43	44 - 44	42 - 42	50 - 50
	Day	0.25	49	49 - 49	53 - 53	44 - 44	64 - 64
22/02/2017	Night	0.25	50	50 - 50	51 - 51	48 - 48	59 - 59
	Day	0.0	-(2)	-(2)	-(2)	-(2)	-(2)
23/02/2017	Night	0.25	51	51 - 51	53 - 53	48 - 48	68 - 68
	Day	0.75	54	53 - 55	55 - 56	51 - 52	63 - 70
24/02/2017	Night	5.0	51	49 - 53	50 - 54	48 - 51	52 - 66
	Day	10.0	50	41 - 56	42 - 59	39 - 51	51 - 74
25/02/2017	Night	0.25	49	49 - 49	51 - 51	45 - 45	72 - 72
	Day	0.0	-(2)	-(2)	-(2)	-(2)	-(2)
26/02/2017	Night	1.75	42	41 - 43	42 - 44	40 - 41	45 - 59
	Day	0.0	-(2)	-(2)	-(2)	-(2)	-(2)
27/02/2017	Night	2.0	42	41 - 43	42 - 45	40 - 42	46 - 56
	Day	7.75	50	44 - 67	45 - 58	42 - 49	49 - 87
28/02/2017	Night	7.0	50	46 - 53	47 - 56	44 - 50	49 - 65
	Day	0.25	52	52 - 52	54 - 54	48 - 48	63 - 63
01/03/2017	Night	4.5	44	42 - 49	43 - 51	41 - 43	45 - 76
	Day	8.5	51	47 - 55	51 - 59	41 - 49	59 - 74

1) The measurement period indicates, for each day or night-time period, the number of hours of valid measurement data that were recorded after measurements made during adverse weather were removed.

2) No valid measurement data were recorder on this day because of adverse weather.

During site visits, it was noted that the noise environment at this location was dominated by equipment within the refinery.

The results show that the representative background sound level, L_{A90,15minutes} (following the method in BS 4142) at this location was 42 dB during the day and 41 dB at night. However, background sound levels are often higher than this value, being 44 dB(A) or above for approximately half of the valid measured samples as shown graphically above.

When considering the range of day and night-time period L_{eq,T} average sound levels measured during the survey, periods where more than half of the measurement period was discarded as a result of adverse weather have been excluded. Following this, five daytime and six night time periods remain.

During the daytime, the period L_{Aeq} ranged between 47 dB and 51 dB. During the night, the period L_{Aeq} ranged between 42 dB and 51 dB. The period day and night values are shown in *Figure 1.6* and *Figure 1.7*.

Figure 1.6 Daytime Period L_{Aeq} Sound Levels

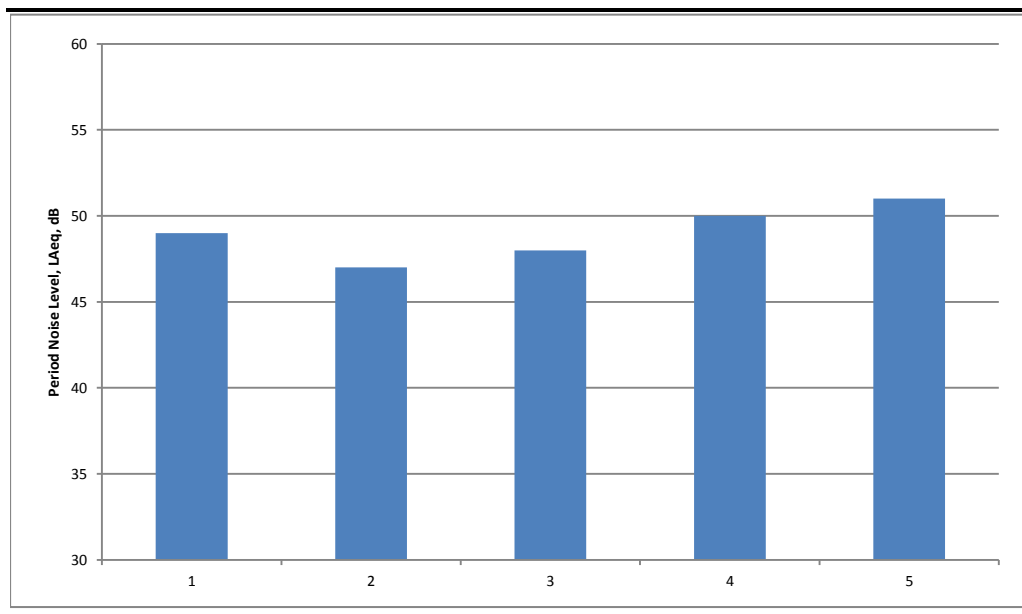
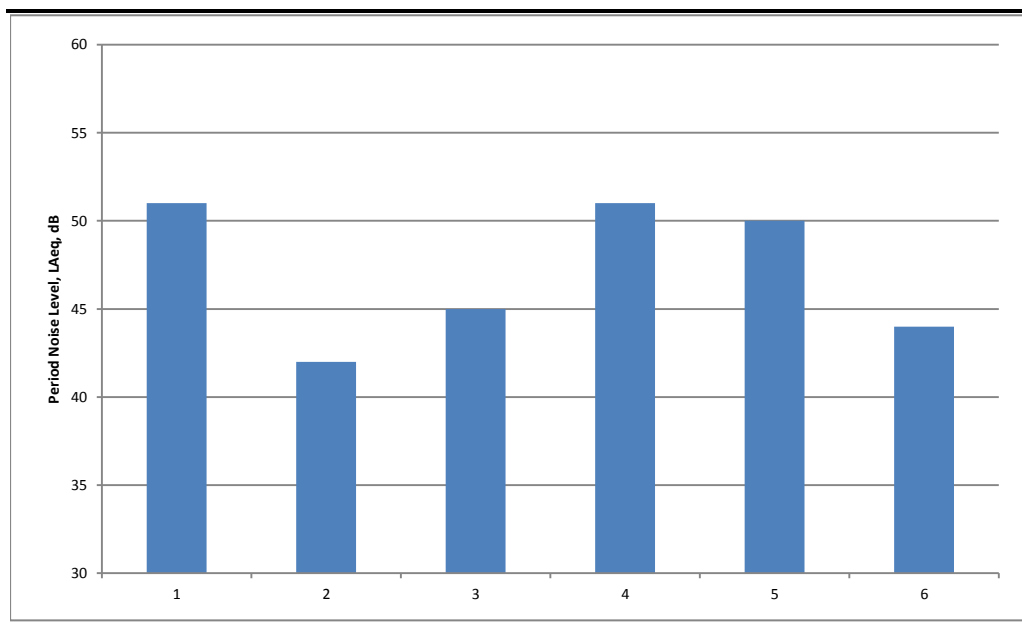


Figure 1.7 Night-Time Period L_{Aeq} Sound Levels



The individual measurements for each period sound level have also been plotted below in Figure 1.8 to Figure 1.18, indicating where gaps in the data occur as a result of adverse weather.

Figure 1.8 *Night-time Period Average Sound Level from the 17th to the 18th February*

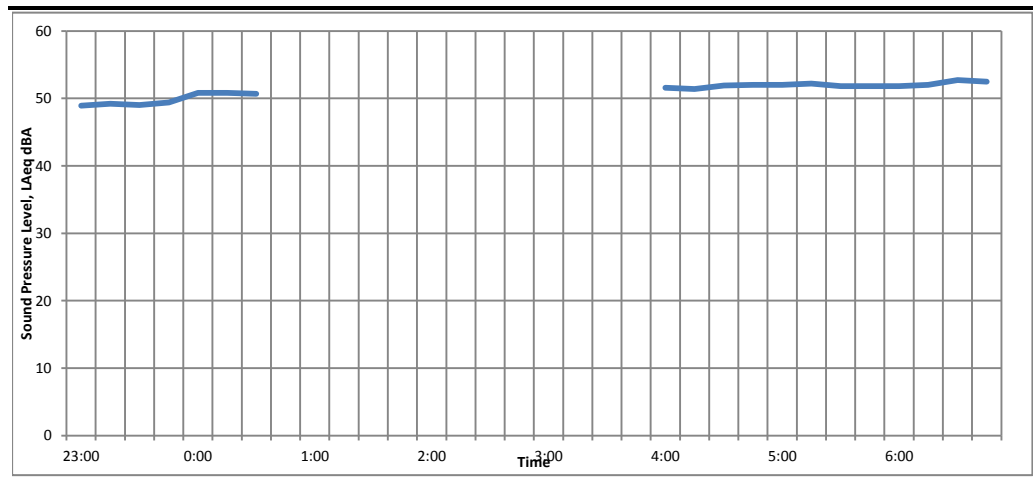


Figure 1.9 *Daytime Period Average Sound Level on the 18th February*

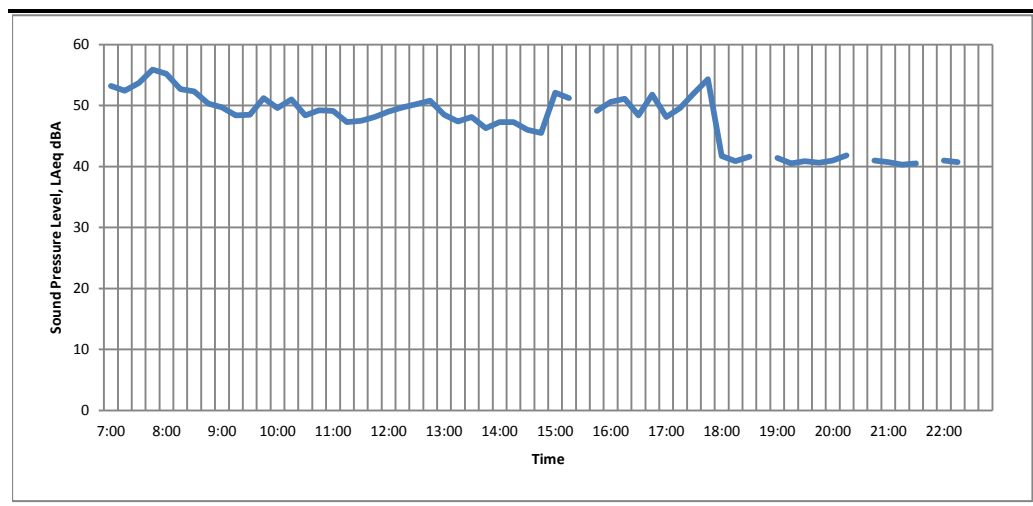


Figure 1.10 *Night-time Period Average Sound Level from the 18th to the 19th February*

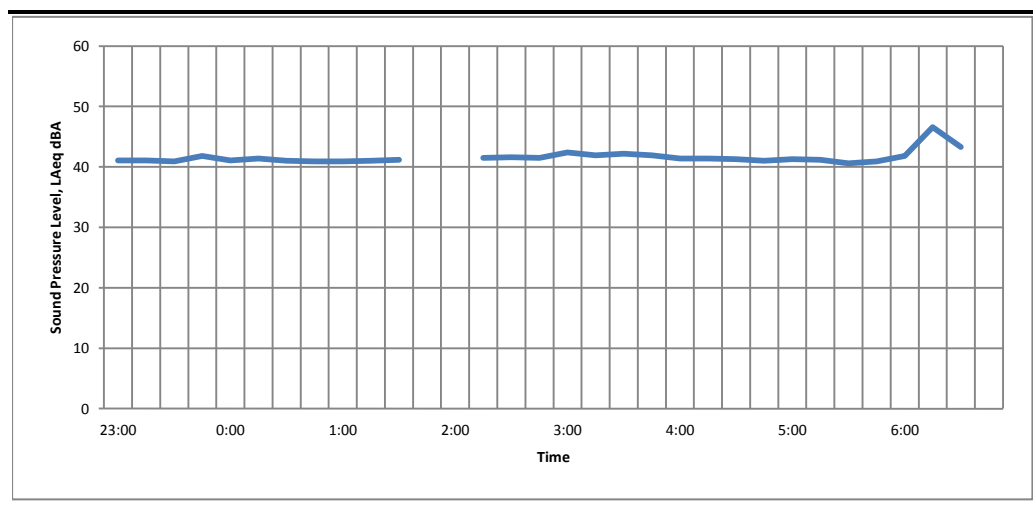


Figure 1.11 Daytime Period Average Sound Level on the 19th February

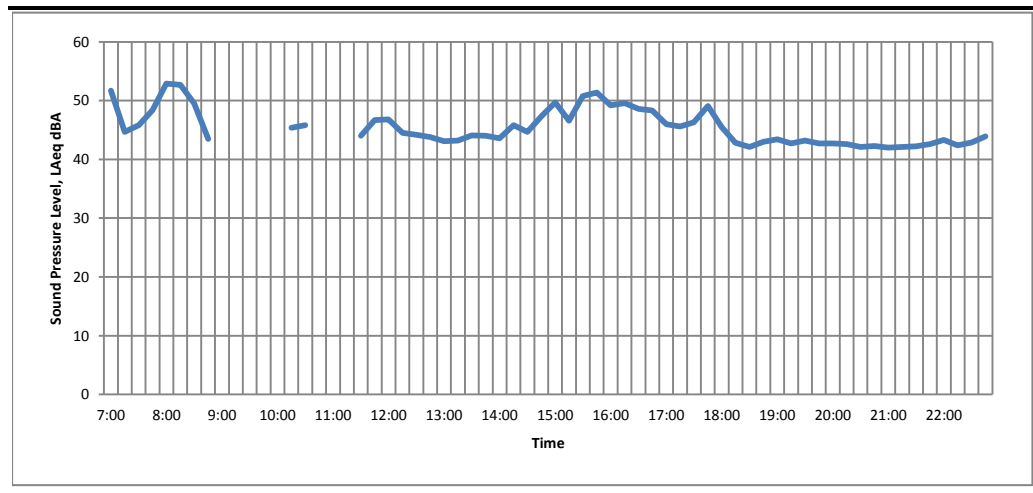


Figure 1.12 Night-time Period Average Sound Level from the 19th to the 20th February

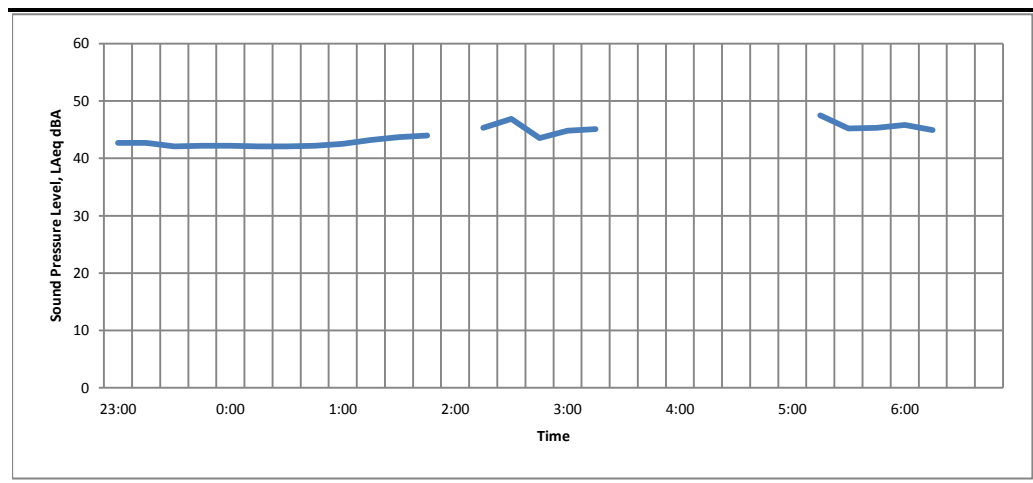


Figure 1.13 Daytime Period Average Sound Level on the 20th February

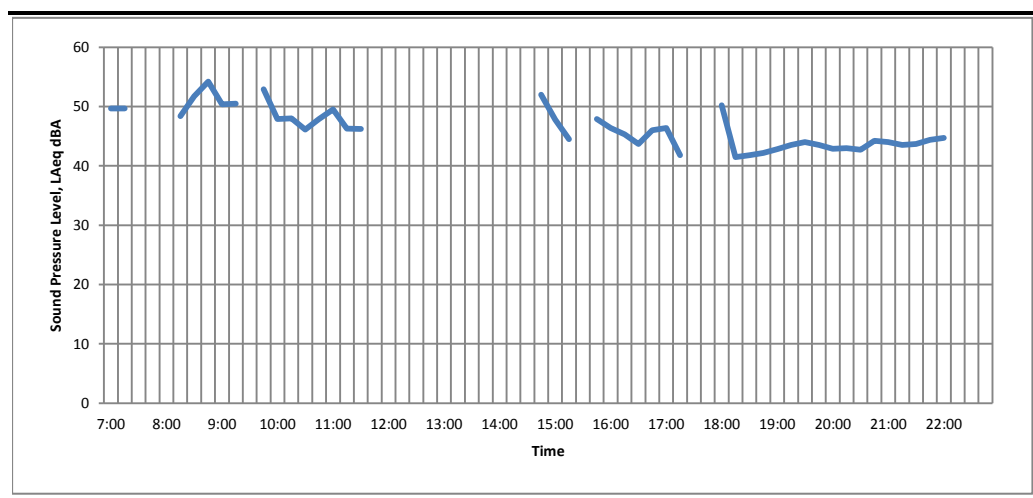


Figure 1.14 *Night-time Period Average Sound Level from the 23rd to the 24th February*

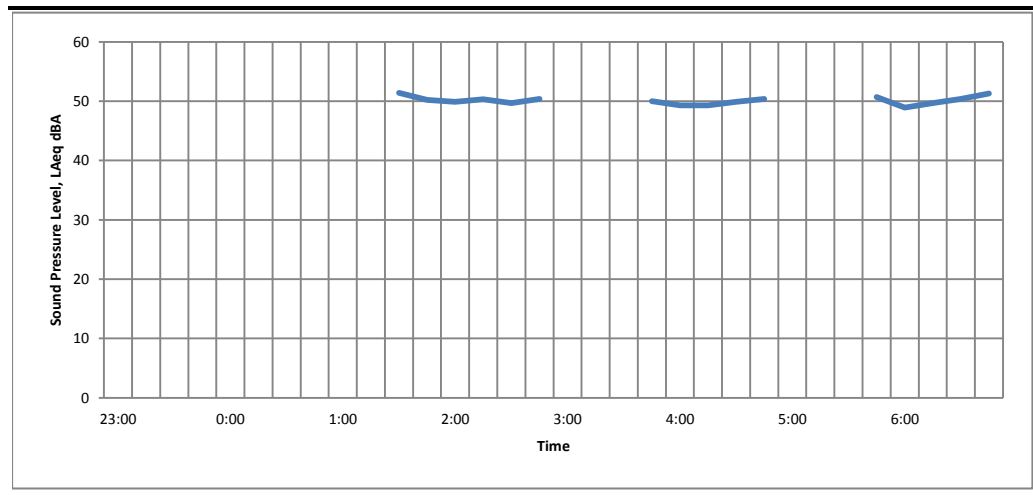


Figure 1.15 *Daytime Period Average Sound Level on the 24th February*

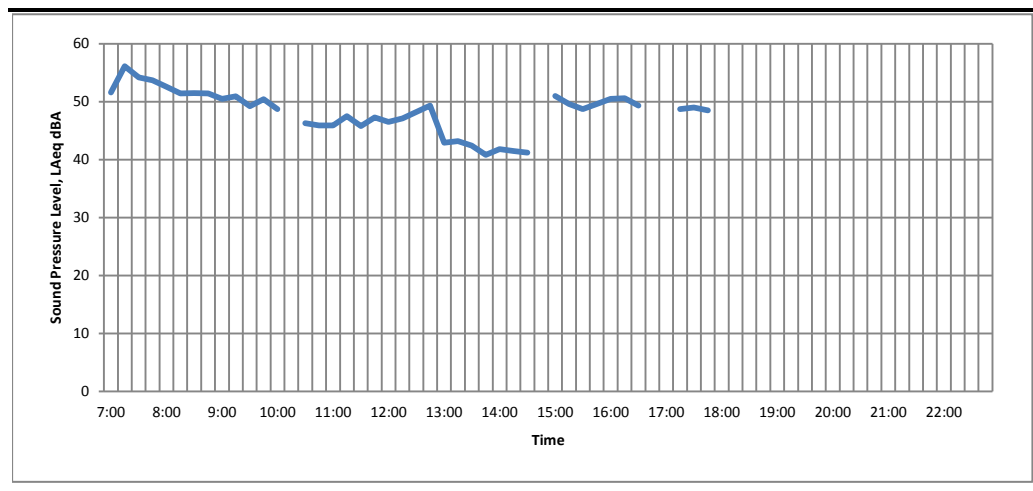


Figure 1.16 *Night-time Period Average Sound Level from the 27th to the 28th February*

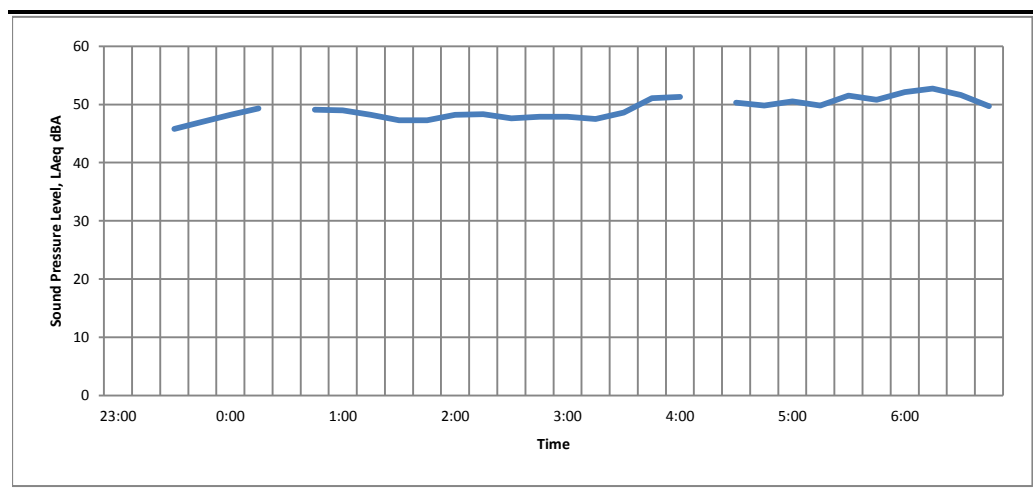


Figure 1.17 *Night-time Period Average Sound Level from the 28th to the 29th February*

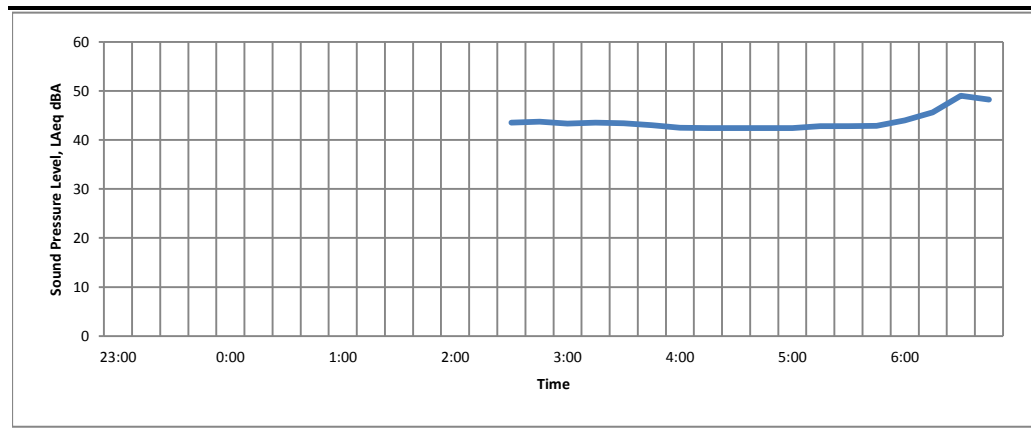
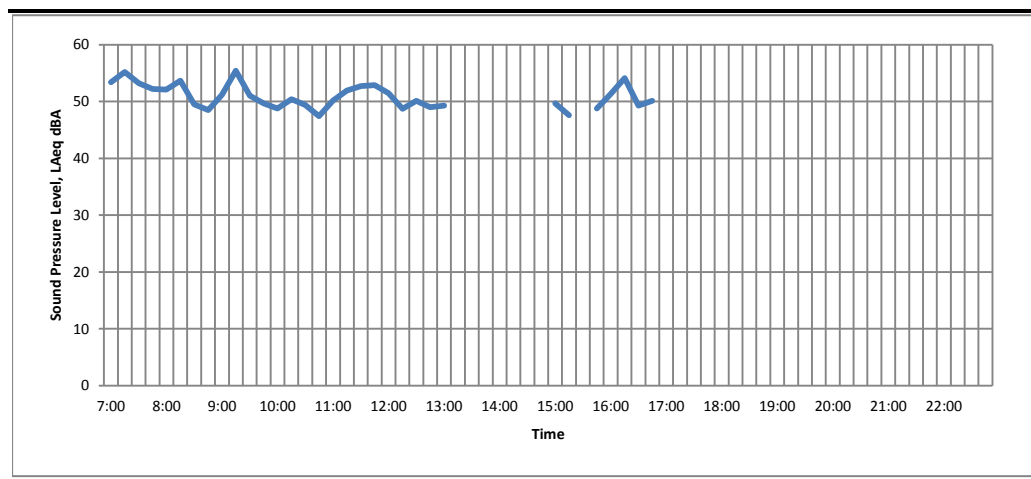


Figure 1.18 *Daytime Period Average Sound Level on the 1st March*



The Effect of Wind Direction on Measured Levels

Figure 1.2 and Figure 1.3 show the spread of background sound levels, $L_{A90,15min}$, during the daytime and night-time periods. Although the results for each period show a clear peak at the modal value, there is some variability in the data and lesser peaks also occur at higher background noise levels.

The effect of wind direction on the measured sound levels has been considered. Figure 1.19 and Figure 1.20 below shows the spread of background sound levels, $L_{A90,15min}$, for the daytime and night-time during periods when the wind direction was south-westerly (the prevailing wind direction).

Figure 1.19 *Spread of Background Sound Levels, $L_{A90,15min}$, During the Daytime for a South-Westerly Wind Direction (203° - 247°)*

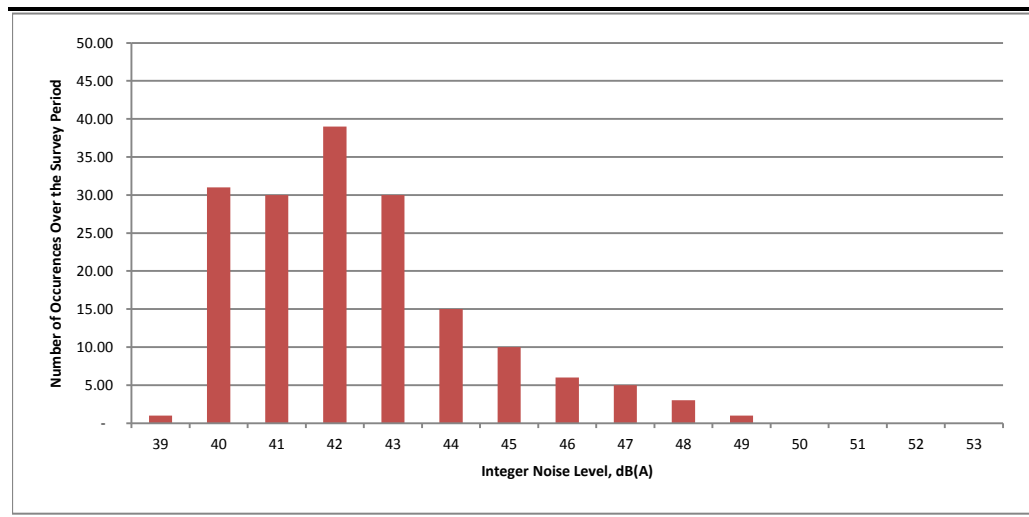
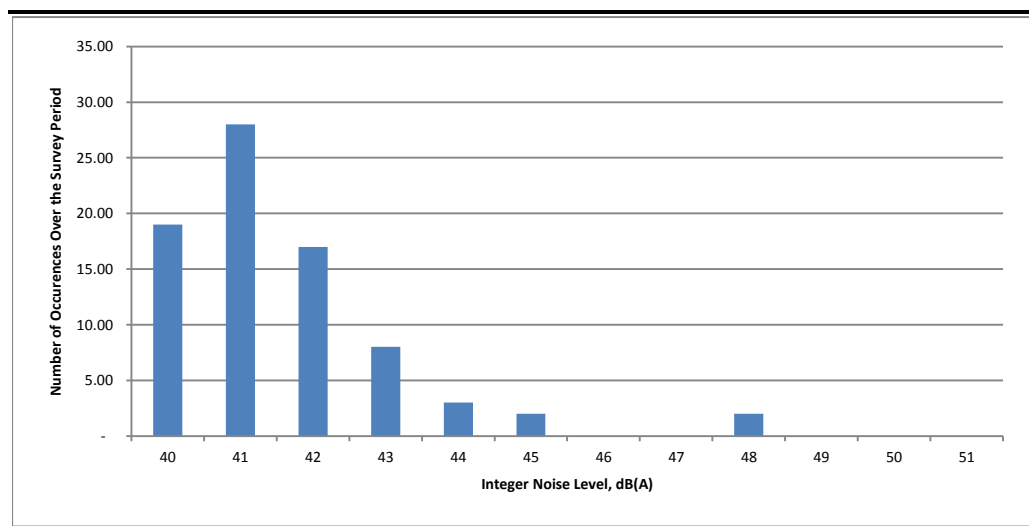


Figure 1.20 *Spread of Background Sound Levels, $L_{A90,15min}$, During the Night-time for a South-Westerly Wind Direction (203° - 247°)*



The results show a significant reduction in variability, suggesting that the higher noise levels tend to occur when the wind comes from other directions.

Figure 1.21 and Figure 1.22 below present the modal $L_{A90,15minute}$ values measured during different wind directions. Figure 1.23 and Figure 1.24 below present the modal $L_{Aeq,15minute}$ values measured during different wind directions.

Figure 1.21 *Modal $L_{A90,15\text{minute}}$ Values Measured During Different Wind Directions During the Daytime*

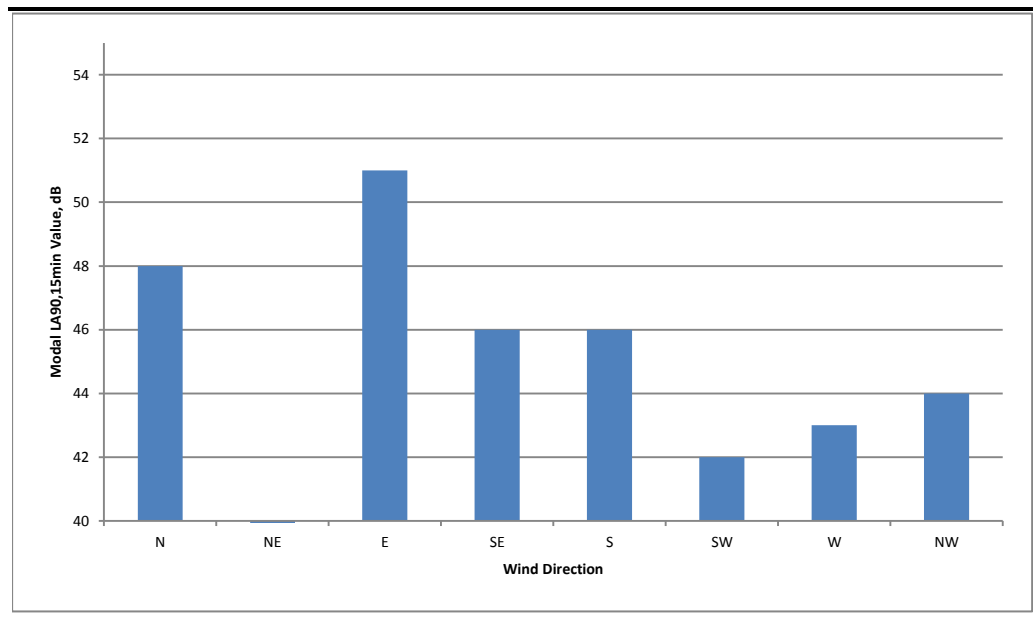


Figure 1.22 *Modal $L_{A90,15\text{minute}}$ Values Measured During Different Wind Directions During the Night-Time*

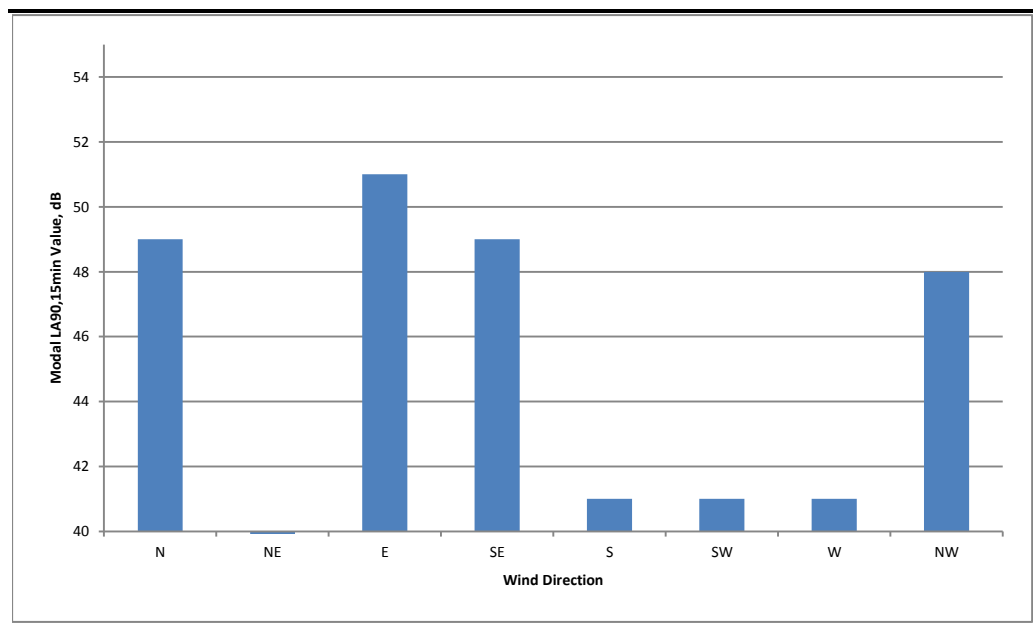


Figure 1.23 *Modal $L_{Aeq,15minute}$ Values Measured During Different Wind Directions During the Daytime*

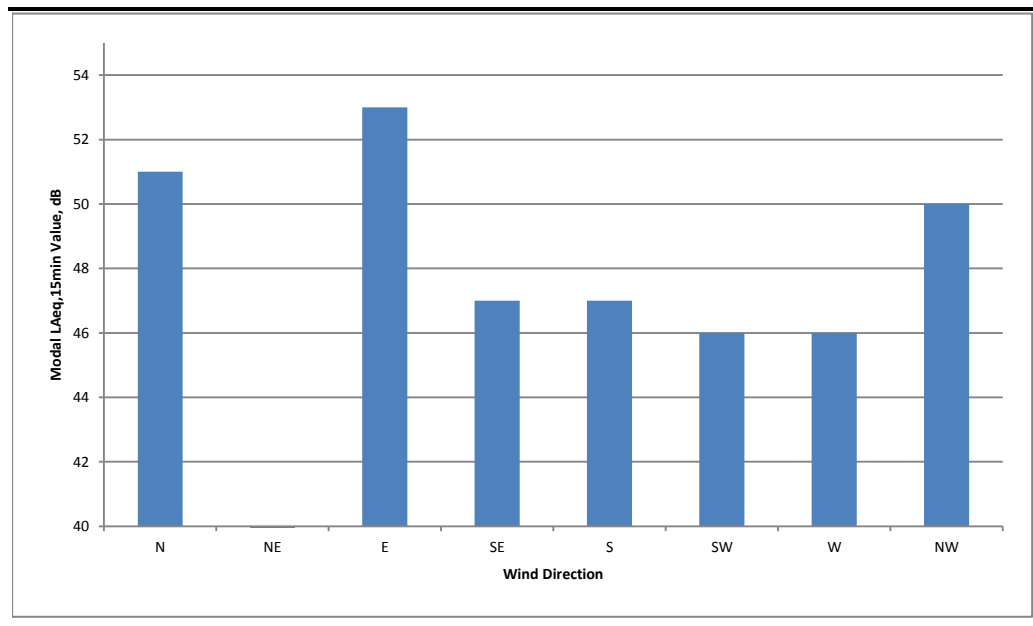
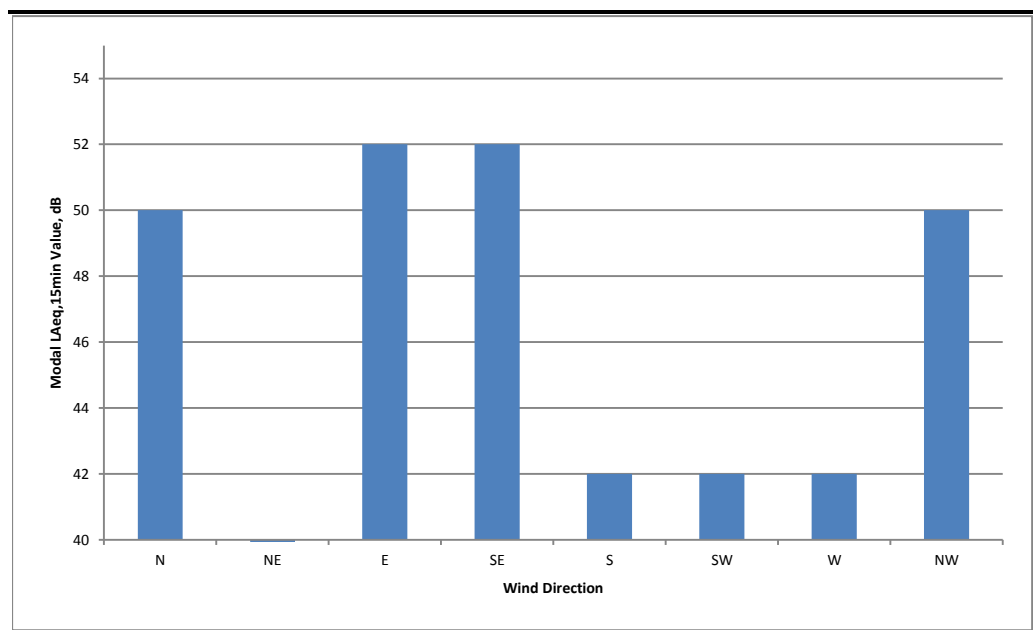


Figure 1.24 *Modal $L_{Aeq,15minute}$ Values Measured During Different Wind Directions During the Night-Time*



The results at night show lower sound levels during southern and western wind directions, and higher sound levels for northern wind directions when Rhoscrowther is downwind of the Refinery. During the day a similar pattern can be seen.

Figure 1.25 presents the occurrence of wind direction during the survey period as well as for historic meteorological data measured at the Refinery (2015 and 2016).

Figure 1.25 *Percentage Occurrence of Wind Direction during the Survey Period as well as Historically*

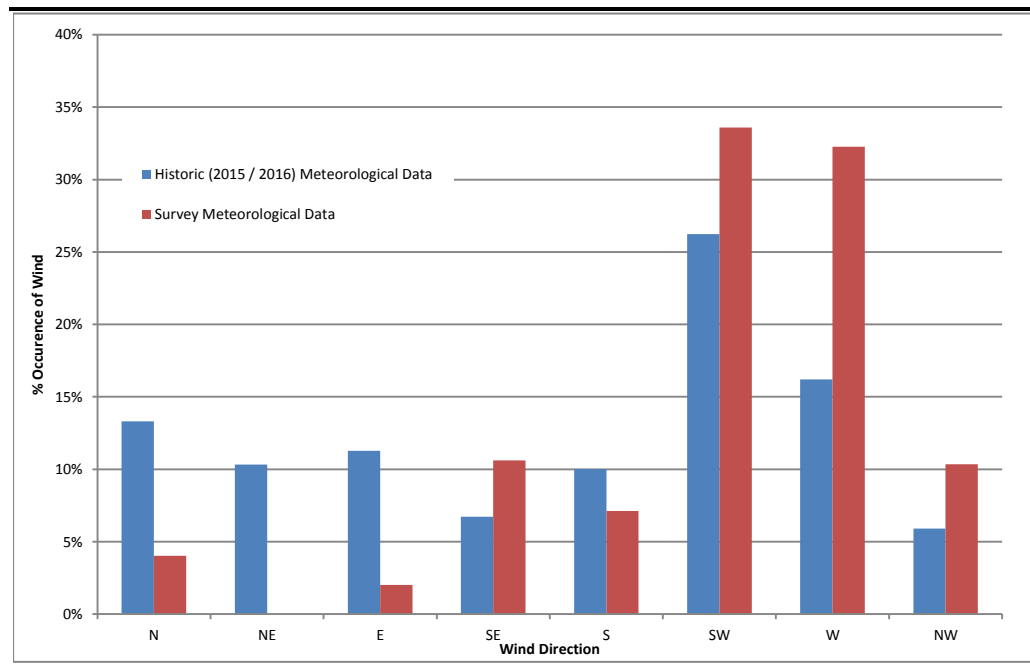


Figure 1.25 shows that, during the survey, more wind occurred from the south-west and west directions than typical.

Noise Monitoring Comparing Noise Levels at Rhoscrowther Village Hall with Noise Levels at 4 Pleasant View

The baseline noise monitoring outlined above was carried out at Rhoscrowther Village Hall. Noise levels at 4 Pleasant View have also been quantified. 4 Pleasant View is closer to residential properties in Rhoscrowther than the Village Hall and is therefore considered to be more representative of the baseline noise environment experienced by residents of Rhoscrowther.

Simultaneous noise measurements were logged at the Village Hall and 4 Pleasant View between the 21st and the 24th April 2017. No periods of high winds which may have adversely affected measurements (ie wind speeds above 10 m/s) were encountered during the survey and therefore no measurements have been excluded.

The results are presented in *Figure 1.26* and *Figure 1.27*.

Figure 1.26 *Simultaneous Noise Measurements Logged at the Village Hall and 4 Pleasant View*

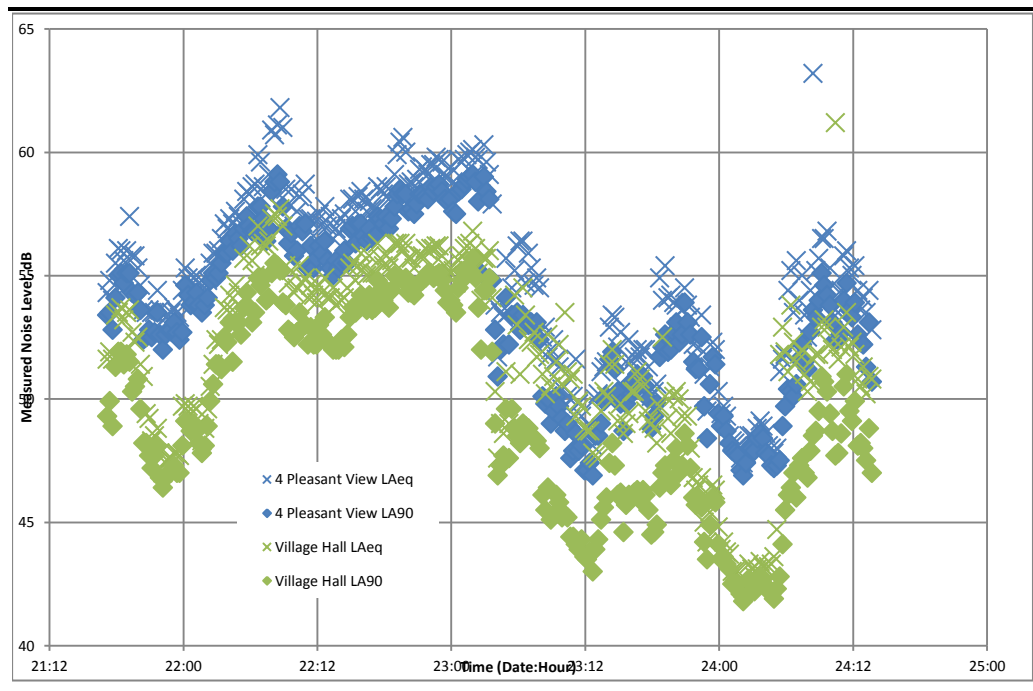
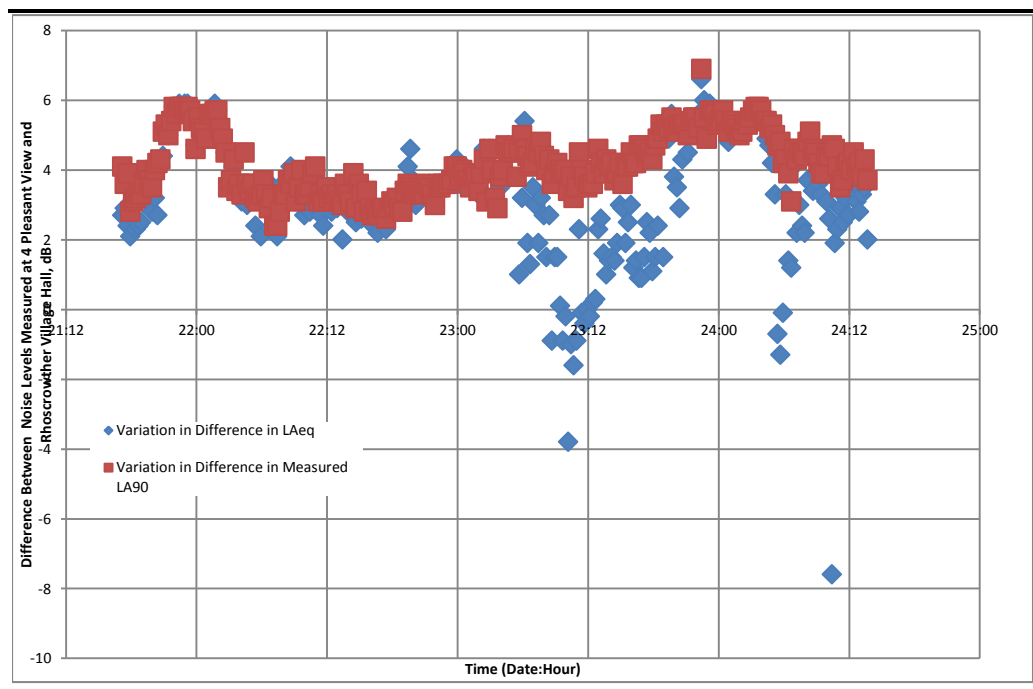


Figure 1.27 *Variation in the Difference Between Noise Measurements Logged at the Village Hall and 4 Pleasant View*



The results show that noise levels at 4 Pleasant View are consistently higher than at the Village Hall. The (arithmetic) average difference in the measured L_{A90} levels was 4.2 dB. Variability in the difference in L_{90} measurements is small. Excluding a single extraneous measurement, somewhat higher than the rest, gives a variability (range of measured differences) of 3.4 dB (with differences ranging between 2.4 dB and 5.8 dB).

When considering the L_{Aeq} levels, are more sensitive to brief sounds, it can be seen that, although the variability in the difference is normally small, there are several extraneous measurements which do not affect the L_{A90} measurements. Smaller differences between L_{Aeq} noise levels at Rhoscrowther Village Hall and 4 Pleasant View than normal were noted on two occasions, for a period of several hours. During these periods L_{Aeq} levels at the Village Hall appeared to be elevated, as they exceeded L_{A90} levels by more than usual, suggesting they were influenced by brief noises that did not influence the L_{A90} measurements. Excluding these two periods (as well as two extraneous measurements) results in an (arithmetic) average difference in the measured L_{Aeq} levels of 3.6 dB with a variability of 3.9 dB (differences ranging between 2.0 dB and 5.9 dB). These results are similar to the difference in L_{A90} measurements. Without excluding these periods (but excluding five extraneous measurements) results in an (arithmetic) average difference in the measured L_{Aeq} levels of 3.2 dB with a variability of 14.2 dB (differences ranging between -7.6 dB and 6.6 dB).

The results of this noise monitoring have been used to adjust the February / March baseline noise survey results (L_{A90} and L_{Aeq} levels) at Rhoscrowther by +4 dB, based on the arithmetic average difference in noise level measured at the two monitoring locations, rounded to zero decimal places. It is noted that baseline L_{Aeq} levels may be lower at times. L_{Aeq} baseline noise levels are used in the noise impact assessment when considering effects based on fixed guidelines values such as those set out in BS 8233. The use of higher L_{Aeq} baseline noise levels results in a conservative assessment of effects on the external amenity and does not affect the assessment of effects during the night.

Construction Noise Baseline

The 'ABC' method set out in BS 5228 has been used to assess potential noise impacts during temporary activities. This method requires a knowledge of the existing average sound level, $L_{Aeq,T}$, for the following periods:

- weekday (07.00 – 19.00);
- weekday evening (19.00 – 23.00);
- night time (23.00 – 07.00);
- Saturday (07.00 – 13.00);
- Saturday (13.00 – 23.00); and
- Sunday (07.00 – 23.00).

A range of daytime (07.00 – 23.00) and night time (23.00 – 07.00) period average sound level values, $L_{Aeq,T}$, are presented earlier in this section. In deriving these period sound levels, days and nights where more than half of the measurement period was discarded as a result of adverse weather were excluded.

The data have been reprocessed in order to derive the period average sound levels listed above. As before, in deriving these period sound levels, days and

evenings where more than half of the measurement period was discarded as a result of adverse weather have been excluded. The results are presented in *Table 1.4*.

Table 1.4 *Period Average Sound Levels to Inform Construction Assessment*

Period	Range of Measured Sound Levels, $L_{Aeq,T}$ dB	Arithmetic Average Sound Level, $L_{Aeq,T}$ dB	'A,B,C' Method Construction Criteria Category
Weekday (07.00 – 19.00)	47 - 55	52	A
Weekday evening (19.00 – 23.00)	48 - 52	50	A
Night-time (23.00 – 07.00)	46 - 55	51	C
Saturday (07.00 – 13.00)	55	55	A
Saturday (13.00 – 23.00)	52	52	A
Sunday (07.00 – 23.00)	51	51	A

1) Values include an adjustment to take account of the difference between noise levels measured at the Village Hall and 4 Pleasant View (see above for details).

1.3.3 *Eastington Farm*

Measurements were carried out for this application for approximately four weeks between 2nd February and the 2nd March 2017. After discarding those measurements carried out during periods of rain or when wind speeds were above 5 m/s, a total of 748 daytime and 462 night time 15 minute measurements remain.

Results

Figure 1.28 presents the sound levels measured during the survey. *Figure 1.29* and *Figure 1.30* show the spread of background sound level values, $L_{A90,15minutes}$, measured during the daytime and night time respectively.

Table 1.5 presents average period sound levels as well as the range of other noise metrics recorded on each day during the survey.

Figure 1.28 Sound Levels (Free-field) Measured During the Survey at Eastington Farm (Measurements During Adverse Weather Not Removed)

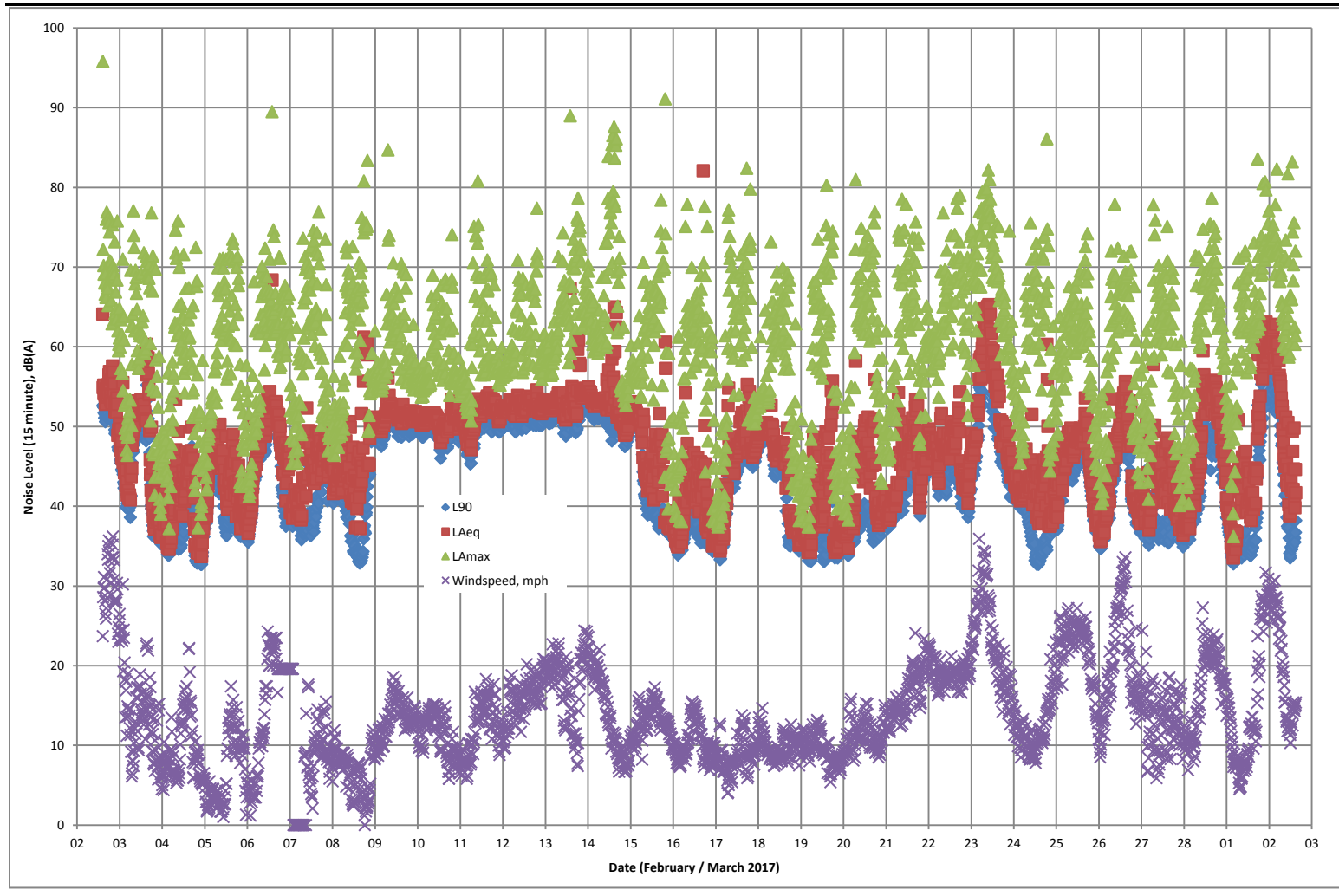


Figure 1.29 *Spread of (Free-field) Background Sound Levels, $L_{A90,15\text{minute}}$, Measured During the Daytime (Measurements During Adverse Weather Have Been Removed)*

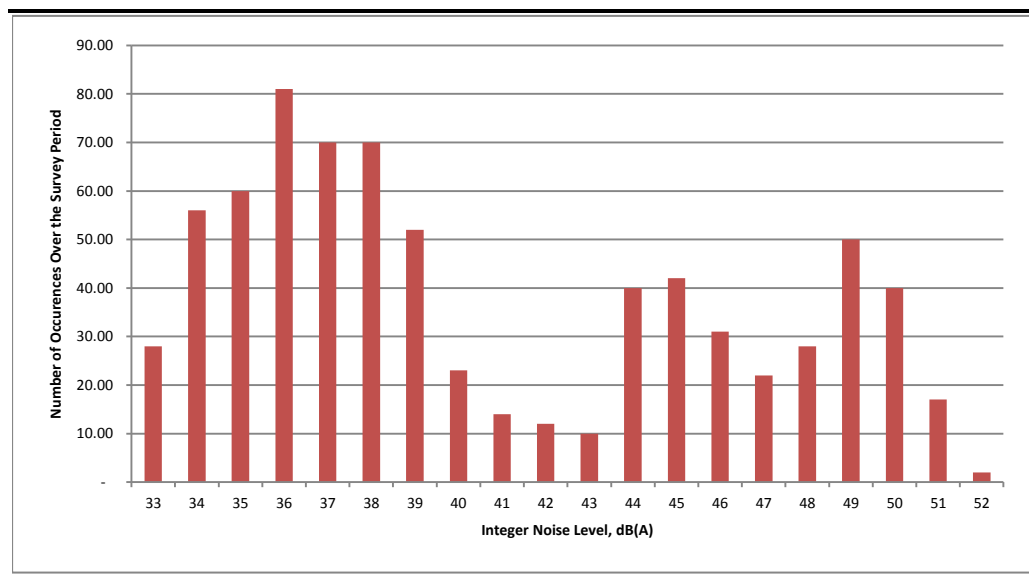


Figure 1.30 *Spread of (Free-field) Background Sound Levels, $L_{A90,15\text{minute}}$, Measured During the Night Time (Measurements During Adverse Weather Have Been Removed)*

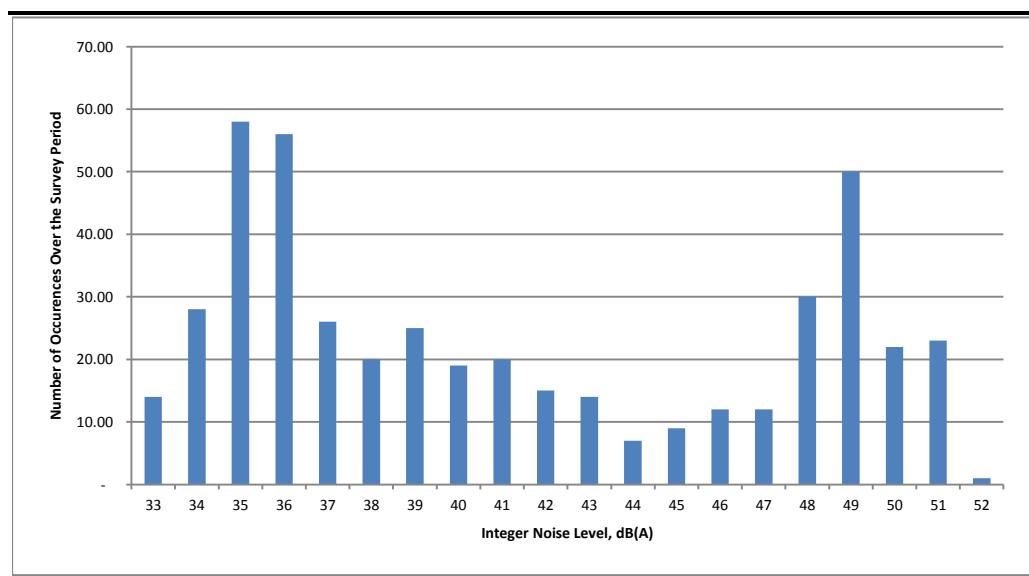


Table 1.5 *Period Sound Levels and Other Noise Metrics (Free-field) Recorded on Each Day of the Survey (Measurements During Adverse Weather Have Been Removed)*

Date	Day/ Night	Measurement Period (hours)	Range of 15 minute measurements, dB				
			$L_{Aeq,period}$	L_{Aeq}	L_{A10}	L_{A90}	L_{Amax}
03/02/2017	Night	1.0	44	41 - 45	42 - 46	39 - 44	50 - 70
	Day	7.5	47	37 - 53	38 - 55	36 - 49	41 - 77
	Night	8.0	39	35 - 45	35 - 47	34 - 42	37 - 58

Date	Day/ Night	Measurement Period (hours)	Range of 15 minute measurements, dB				
			L _{Aeq,period}	L _{Aeq}	L _{A10}	L _{A90}	L _{Amax}
04/02/2017	Day	9.3	43	34 - 53	35 - 54	33 - 41	37 - 76
	Night	8.0	46	37 - 50	38 - 51	36 - 49	42 - 57
05/02/2017	Day	15.0	44	37 - 50	38 - 52	36 - 45	43 - 74
	Night	8.0	44	37 - 50	38 - 52	36 - 47	41 - 68
06/02/2017	Day	2.8	49	47 - 50	49 - 52	46 - 47	53 - 70
	Night	0.0	-(1)	-(1)	-(1)	-(1)	-(1)
07/02/2017	Day	12.8	46	41 - 50	43 - 52	36 - 48	47 - 77
	Night	8.0	44	42 - 47	43 - 48	40 - 46	46 - 59
08/02/2017	Day	15.5	53	37 - 61	38 - 66	33 - 50	49 - 83
	Night	6.3	50	49 - 51	51 - 53	48 - 50	55 - 62
09/02/2017	Day	2.3	52	51 - 56	52 - 56	49 - 50	56 - 85
	Night	3.3	51	50 - 52	51 - 53	49 - 50	54 - 58
10/02/2017	Day	10.3	51	48 - 53	50 - 54	46 - 51	54 - 74
	Night	8.0	50	47 - 52	49 - 54	45 - 51	51 - 61
11/02/2017	Day	5.8	52	50 - 54	51 - 56	47 - 52	55 - 75
	Night	4.3	52	52 - 53	53 - 54	50 - 51	56 - 60
12/02/2017	Day	0.8	52	52 - 53	53 - 54	50 - 51	64 - 71
	Night	0.3	53	53 - 53	54 - 54	51 - 51	61 - 61
13/02/2017	Day	3.0	56	51 - 61	52 - 66	49 - 52	62 - 79
	Night	0.3	53	53 - 53	54 - 54	51 - 51	66 - 66
14/02/2017	Day	9.5	56	49 - 65	50 - 59	48 - 50	53 - 88
	Night	4.5	52	50 - 53	51 - 55	48 - 52	55 - 60
15/02/2017	Day	0.3	46	46 - 46	48 - 48	44 - 44	57 - 57
	Night	7.5	38	35 - 41	36 - 44	34 - 38	38 - 61
16/02/2017	Day	9.3	44	35 - 54	36 - 56	34 - 39	38 - 78
	Night	8.0	38	34 - 45	36 - 46	33 - 42	37 - 61
17/02/2017	Day	14.0	49	44 - 55	45 - 59	42 - 48	50 - 82
	Night	5.5	50	48 - 51	49 - 52	47 - 49	52 - 65
18/02/2017	Day	14.8	46	36 - 53	37 - 54	35 - 49	41 - 73
	Night	7.3	36	34 - 41	35 - 44	33 - 37	37 - 58
19/02/2017	Day	14.0	46	34 - 56	35 - 59	33 - 41	40 - 80
	Night	6.0	39	35 - 47	36 - 46	34 - 39	38 - 72
20/02/2017	Day	11.3	47	38 - 58	39 - 61	36 - 40	43 - 81
	Night	0.3	39	39 - 39	40 - 40	38 - 38	49 - 49
21/02/2017	Day	0.3	45	45 - 45	46 - 46	39 - 39	69 - 69
	Night	0.3	48	48 - 48	50 - 50	46 - 46	61 - 61
22/02/2017	Day	0.0	-(1)	-(1)	-(1)	-(1)	-(1)
	Night	0.3	48	48 - 48	49 - 49	45 - 45	68 - 68
23/02/2017	Day	0.8	47	46 - 48	49 - 50	43 - 45	60 - 61
	Night	5.0	42	41 - 46	42 - 48	39 - 42	46 - 65
24/02/2017	Day	10.0	43	38 - 47	38 - 50	33 - 40	55 - 76

Date	Day/ Night	Measurement Period (hours)	Range of 15 minute measurements, dB				
			L _{Aeq,period}	L _{Aeq}	L _{A10}	L _{A90}	L _{Amax}
25/02/2017	Night	0.3	46	46 - 46	49 - 49	42 - 42	59 - 59
	Day	0.0	-(1)	-(1)	-(1)	-(1)	-(1)
26/02/2017	Night	1.8	37	36 - 39	36 - 41	35 - 38	40 - 53
	Day	0.0	-(1)	-(1)	-(1)	-(1)	-(1)
27/02/2017	Night	2.0	39	37 - 41	39 - 44	35 - 39	41 - 59
	Day	8.0	45	37 - 50	38 - 53	36 - 45	40 - 76
28/02/2017	Night	7.0	41	36 - 50	38 - 51	35 - 40	40 - 72
	Day	0.3	45	45 - 45	45 - 45	40 - 40	68 - 68
01/03/2017	Night	4.5	41	34 - 51	34 - 54	33 - 35	36 - 71
	Day	8.5	43	39 - 47	40 - 50	34 - 38	57 - 72
	Night	0.3	59	59 - 59	63 - 63	53 - 53	72 - 72

1) No valid measurement data were recorded on this day because of adverse weather.

The main sources of noise at this location during site visits were bird song and the distant sound of the Refinery. The Refinery produced noise at a relatively constant level at this NSR. Farm machinery could also be heard to the south, in the distance.

The measurements show that higher noise levels were experienced from the evening of Wednesday 8th February, for a period of about six days (see *Figure 1.28*).

Figure 1.29 and *Figure 1.30* show the spread of background sound levels, $L_{A90,15min}$, during the daytime and night-time periods. The results show that the representative background sound level, $L_{A90,15minutes}$ at this location was 36 dB during the day and 35 dB at night. Although the results for each period show a clear peak at the modal value, there is some variability in the data and lesser peaks also occur at higher background noise levels. This variability is significantly reduced when the higher noise levels mentioned above, are removed, as shown in *Figure 1.31* and *Figure 1.32* below.

Figure 1.31 Spread of (Free-field) Background Sound Levels, $L_{A90,15\text{minute}}$, Measured During the Daytime (Measurements from the Evening of Wednesday 8th February, for a Period of Six days and During Adverse Weather Have Been Removed)

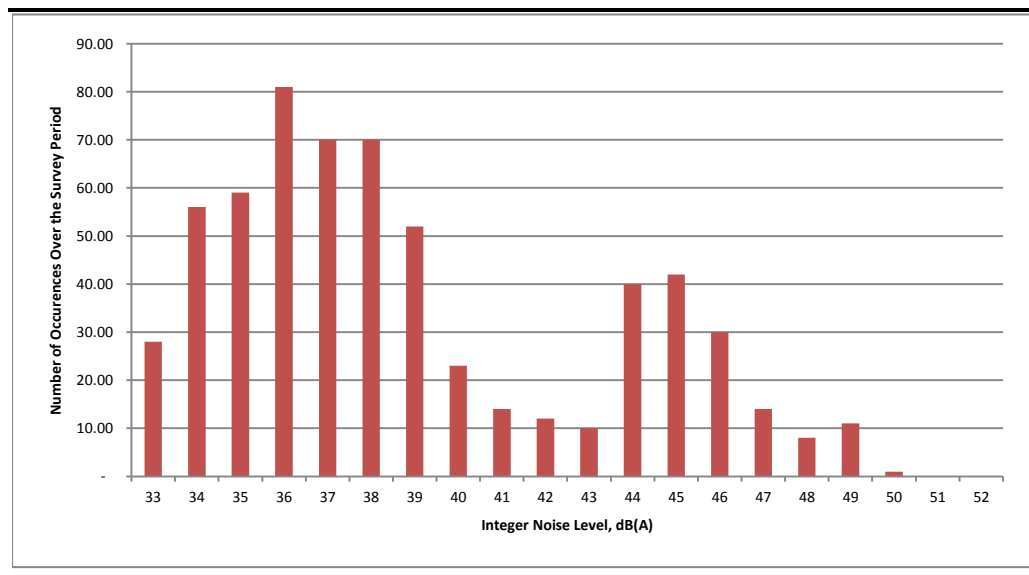
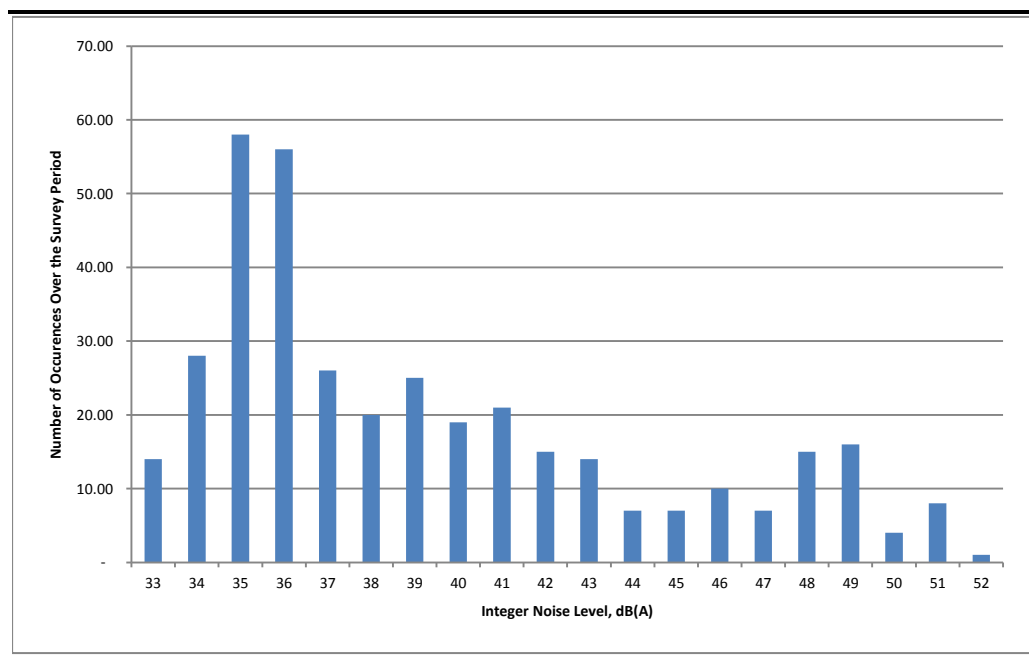


Figure 1.32 Spread of (Free-field) Background Sound Levels, $L_{A90,15\text{minute}}$, Measured During the Night-Time (Measurements from the Evening of Wednesday 8th February, for a Period of Six days and During Adverse Weather Have Been Removed)



When considering the range of day and night-time period $L_{eq,T}$ average sound levels measured during the survey, periods where more than half of the measurement period was discarded as a result of adverse weather have been excluded. Following this, 11 daytime and 12 night time periods remain. During the daytime, the period L_{Aeq} ranged between 43 dB and 49 dB, normally being between approximately 43 – 46 dB. During the night, the period L_{Aeq} ranged between 36 dB and 50 dB and was normally close to 40 dB. The period day and night values are shown in *Figure 1.33* and *Figure 1.34*.

Figure 1.33 *Daytime Period L_{Aeq} Sound Levels*

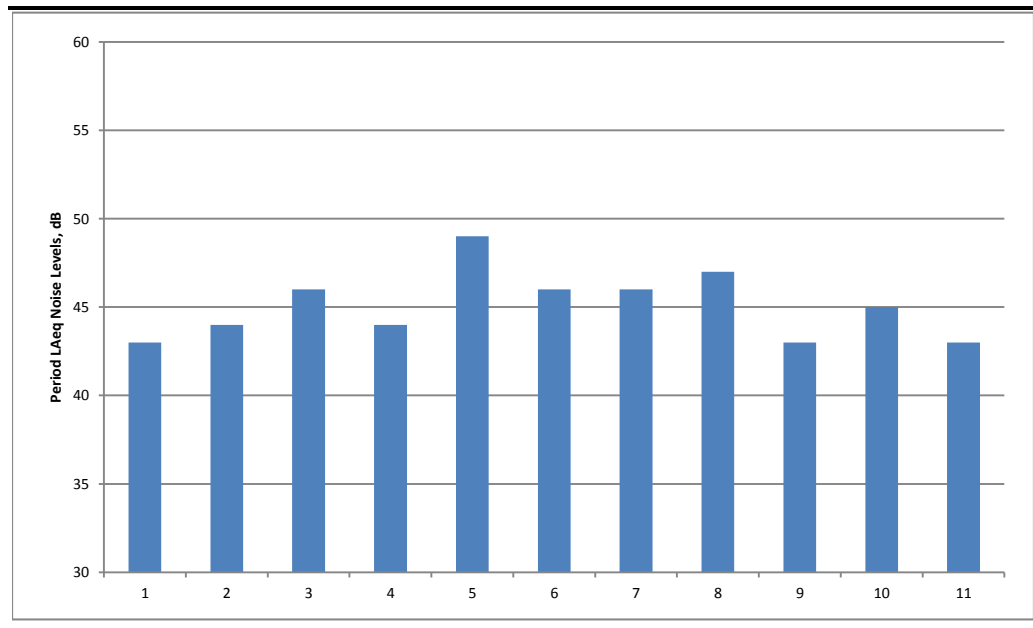
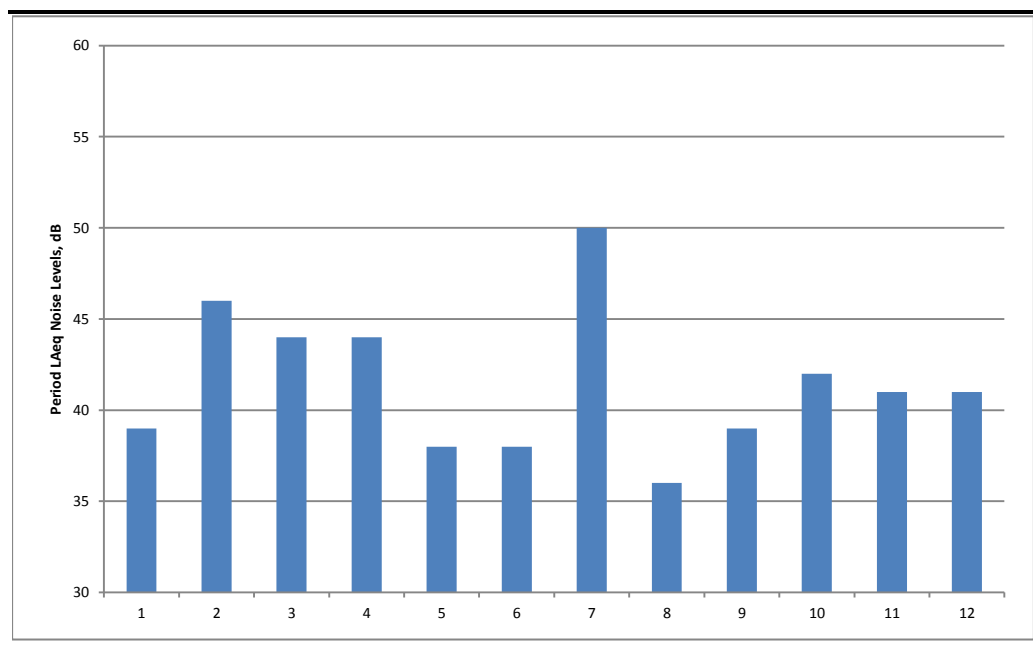


Figure 1.34 *Night-Time Period L_{Aeq} Sound Levels*



Construction Noise Baseline

As described above, the ‘ABC’ method set out in BS 5228 has been used to assess potential noise impacts during temporary activities. This method requires a knowledge of the existing average sound level, $L_{Aeq,T}$, for the following periods:

- weekday (07.00 – 19.00);
- weekday evening (19.00 – 23.00);
- night time (23.00 – 07.00);
- Saturday (07.00 – 13.00);

- Saturday (13.00 – 23.00); and
- Sunday (07.00 – 23.00).

A range of daytime (07.00 – 23.00) and night time (23.00 – 07.00) period average sound level values, $L_{Aeq,T}$, are presented earlier in this section. In deriving these period sound levels, days and nights where more than half of the measurement period was discarded as a result of adverse weather were excluded.

The data have been reprocessed in order to derive the period average sound levels listed above. As before, in deriving these period sound levels, days and evenings where more than half of the measurement period was discarded as a result of adverse weather have been excluded. The results are presented in *Table 1.6*.

Table 1.6 *Period Average Sound Levels to Inform Construction Assessment*

Period	Range of Measured Sound Levels, $L_{Aeq,T}$, dB	Arithmetic Average Sound Level, $L_{Aeq,T}$, dB	'A,B,C' Method Construction Criteria Category
Weekday (07.00 – 19.00)	43 - 52	47	A
Weekday evening (19.00 – 23.00)	38 - 55	46	A
Night-time (23.00 – 07.00)	36 - 50	42	A
Saturday (07.00 – 13.00)	46 - 48	47	A
Saturday (13.00 – 23.00)	39 - 44	42	A
Sunday (07.00 – 23.00)	44 - 46	45	A

1.3.4 *Angle*

Measurements were carried out for approximately four weeks between 2nd February and the 28th February 2017. After discarding those measurements carried out during periods of rain or when wind speeds were above 5 m/s, a total of 703 daytime and 500 night time 15 minute measurements remain.

Results

Figure 1.35 presents the sound levels measured during the survey. *Figure 1.36* and *Figure 1.37* show the spread of background sound level values, $L_{A90,15\text{minutes}}$, measured during the daytime and night time respectively.

Table 1.7 presents average period noise levels as well as the range of other noise metrics recorded on each day during the survey.

Figure 1.35 Sound Levels (Free-field) Measured During the Survey at Angle (Measurements During Adverse Weather Not Removed)

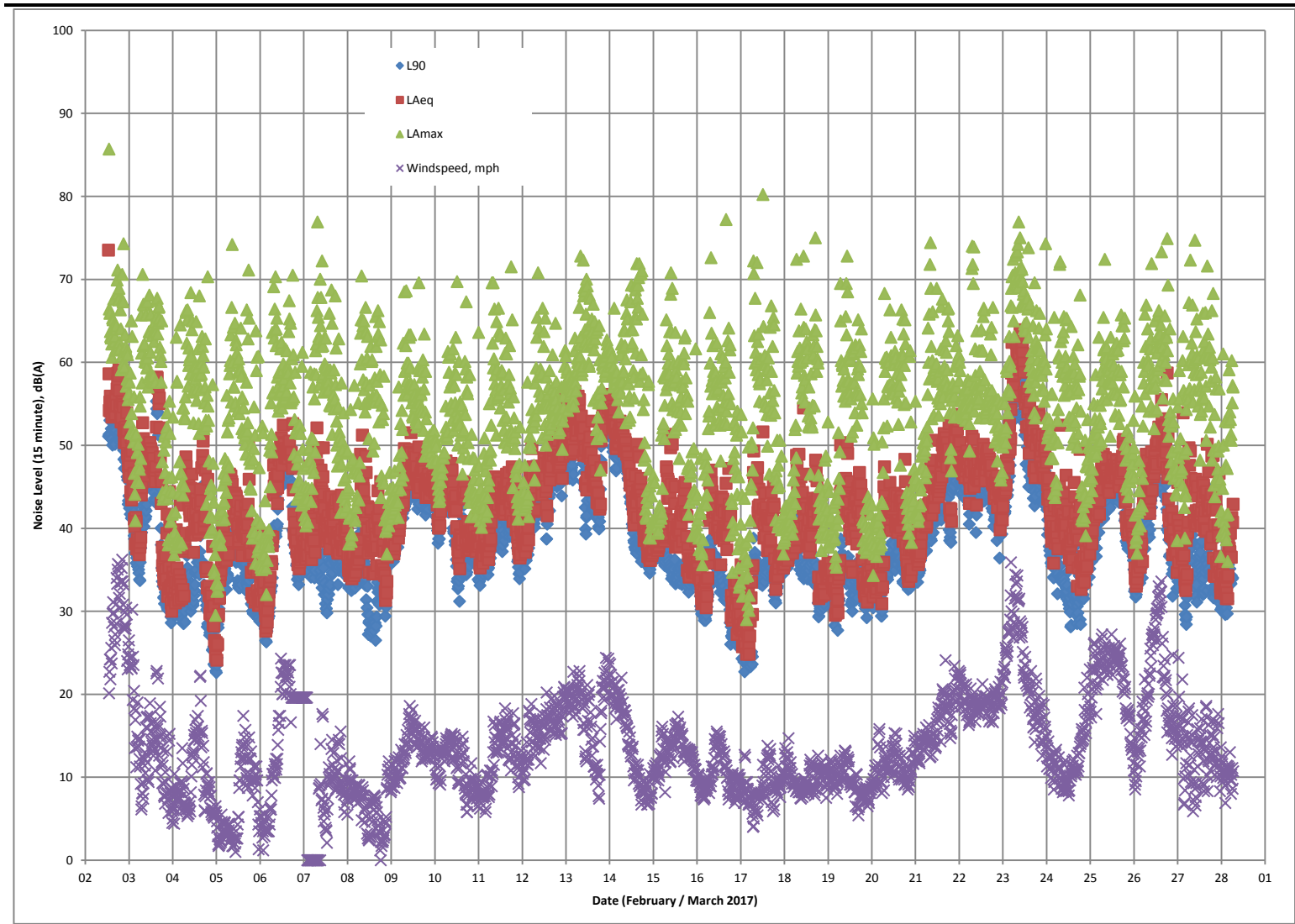


Figure 1.36 Spread of (Free-field) Background Sound Levels, $L_{A90,15\text{minute}}$, Measured During the Daytime (Measurements During Adverse Weather Have Been Removed)

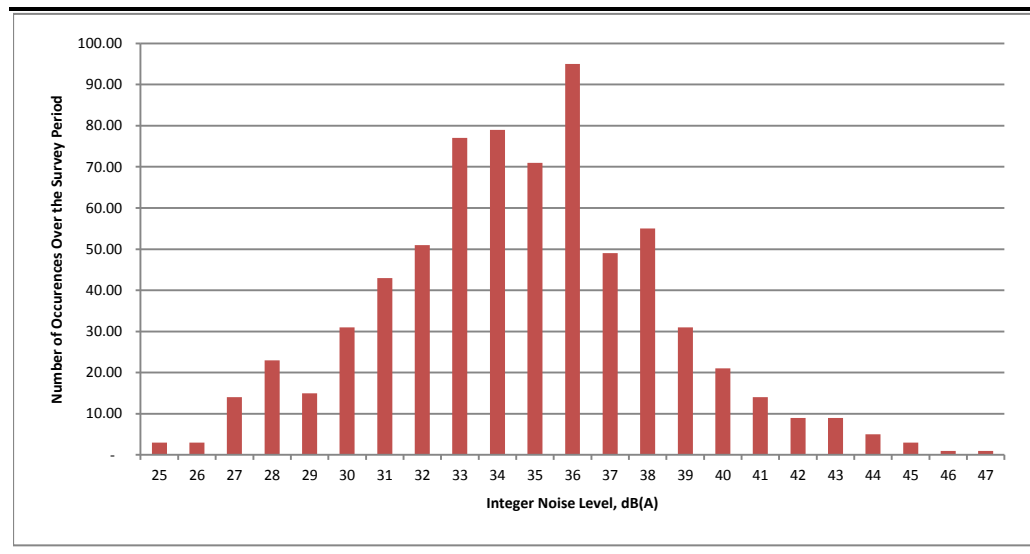


Figure 1.37 Spread of (Free-field) Background Sound Levels, $L_{A90,15\text{minute}}$, Measured During the Night time (Measurements During Adverse Weather Have Been Removed)

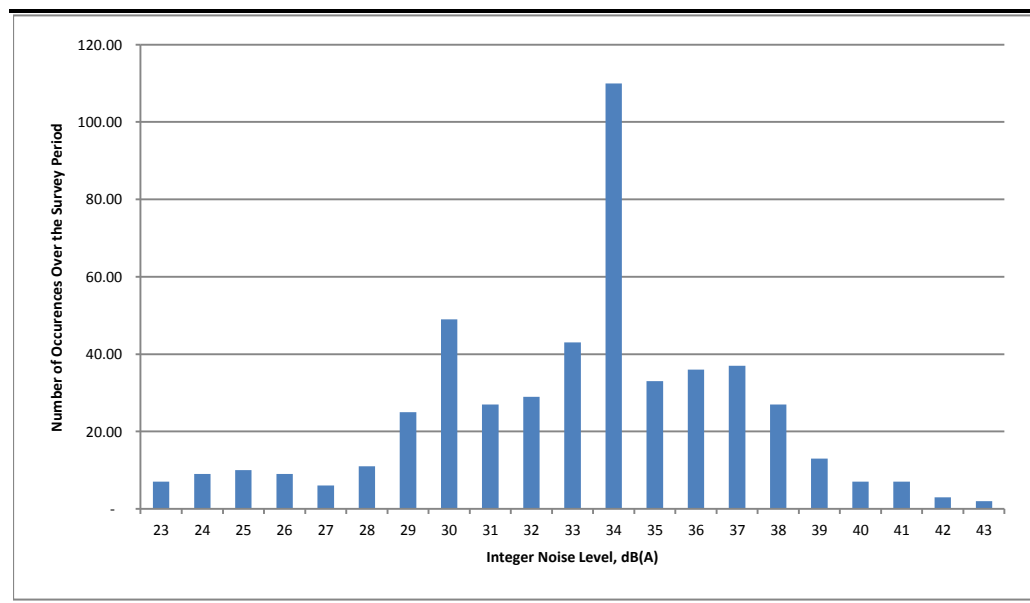


Table 1.7 Period Sound Levels and Other Noise Metrics (Free-field) Recorded on Each Day of the Survey (Measurements During Adverse Weather Have Been Removed)

Date	Day/ Night	Measurement Period (hours)	Range of 15 minute measurements, dB				
			$L_{Aeq,period}$	L_{Aeq}	L_{A10}	L_{A90}	L_{Amax}
03/02/2017	Night	1.0	41	38 - 44	37 - 44	34 - 38	48 - 66
	Day	7.5	44	32 - 53	33 - 55	30 - 43	38 - 71
	Night	8.0	35	30 - 43	31 - 42	29 - 33	37 - 65

Date	Day/ Night	Measurement Period (hours)	Range of 15 minute measurements, dB				
			L _{Aeq,period}	L _{Aeq}	L _{A10}	L _{A90}	L _{Amax}
04/02/2017	Day	9.3	42	28 - 49	29 - 52	25 - 39	35 - 70
	Night	8.0	36	24 - 40	25 - 42	23 - 39	30 - 56
05/02/2017	Day	15.0	42	31 - 50	32 - 50	30 - 40	36 - 74
	Night	8.0	34	28 - 40	28 - 40	26 - 34	32 - 64
06/02/2017	Day	2.8	45	39 - 48	41 - 50	34 - 41	56 - 70
	Night	0.0	-(1)	-(1)	-(1)	-(1)	-(1)
07/02/2017	Day	12.8	41	37 - 45	38 - 49	30 - 39	42 - 72
	Night	8.0	37	34 - 41	35 - 42	33 - 39	38 - 57
08/02/2017	Day	15.5	42	31 - 51	32 - 56	27 - 41	37 - 70
	Night	6.3	40	37 - 43	38 - 44	36 - 42	41 - 57
09/02/2017	Day	2.3	47	44 - 50	45 - 51	42 - 46	51 - 70
	Night	3.3	43	40 - 46	41 - 47	38 - 43	43 - 51
10/02/2017	Day	10.3	40	35 - 46	36 - 48	31 - 43	41 - 70
	Night	8.0	38	35 - 42	37 - 42	33 - 39	40 - 64
11/02/2017	Day	5.8	43	36 - 46	37 - 49	34 - 42	41 - 72
	Night	4.3	39	37 - 41	38 - 44	35 - 38	41 - 58
12/02/2017	Day	0.8	47	46 - 49	47 - 51	43 - 47	56 - 65
	Night	0.3	49	49 - 49	51 - 51	46 - 46	57 - 57
13/02/2017	Day	3.0	46	42 - 51	42 - 56	40 - 45	51 - 66
	Night	0.3	54	54 - 54	57 - 57	51 - 51	67 - 67
14/02/2017	Day	9.5	43	36 - 50	37 - 49	35 - 39	39 - 72
	Night	4.5	38	37 - 39	37 - 40	36 - 38	40 - 58
15/02/2017	Day	0.3	42	42 - 42	45 - 45	36 - 36	57 - 57
	Night	7.5	34	30 - 41	31 - 45	29 - 35	36 - 54
16/02/2017	Day	9.3	41	27 - 47	28 - 51	26 - 39	35 - 77
	Night	8.0	30	25 - 36	25 - 40	23 - 28	29 - 54
17/02/2017	Day	14.0	43	33 - 52	34 - 53	31 - 39	40 - 80
	Night	5.5	40	35 - 49	36 - 52	35 - 38	37 - 72
18/02/2017	Day	14.8	44	32 - 55	33 - 59	29 - 41	37 - 75
	Night	7.3	34	30 - 36	30 - 39	28 - 34	35 - 53
19/02/2017	Day	14.0	42	31 - 50	33 - 53	29 - 41	37 - 73
	Night	6.0	36	31 - 45	32 - 49	29 - 36	34 - 56
20/02/2017	Day	11.3	42	34 - 48	34 - 52	33 - 39	38 - 68
	Night	0.3	38	38 - 38	39 - 39	35 - 35	45 - 45
21/02/2017	Day	0.3	47	47 - 47	50 - 50	41 - 41	66 - 66
	Night	0.3	48	48 - 48	50 - 50	45 - 45	53 - 53
22/02/2017	Day	0.0	-(1)	-(1)	-(1)	-(1)	-(1)
	Night	0.3	48	48 - 48	49 - 49	45 - 45	59 - 59
23/02/2017	Day	0.8	47	46 - 47	49 - 50	43 - 44	53 - 59
	Night	5.0	42	36 - 46	37 - 48	32 - 43	44 - 65
24/02/2017	Day	10.0	42	35 - 52	37 - 56	28 - 40	50 - 72

Date	Day/ Night	Measurement Period (hours)	Range of 15 minute measurements, dB				
			L _{Aeq,period}	L _{Aeq}	L _{A10}	L _{A90}	L _{Amax}
25/02/2017	Night	0.3	46	46 - 46	49 - 49	41 - 41	53 - 53
	Day	0.0	-(1)	-(1)	-(1)	-(1)	-(1)
26/02/2017	Night	1.8	35	33 - 38	34 - 42	32 - 34	38 - 56
	Day	0.0	-(1)	-(1)	-(1)	-(1)	-(1)
27/02/2017	Night	2.0	36	33 - 39	34 - 42	28 - 35	39 - 54
	Day	8.0	43	34 - 49	35 - 52	32 - 40	45 - 75
	Night	7.0	37	32 - 43	33 - 47	30 - 35	36 - 61

1) No valid measurement data were recorded on this day because of adverse weather.

The survey was carried out during the winter months and consequently, the surrounding deciduous trees, which made up most of the trees nearby, did not have leaves. During windy weather, however, tree noise and noise from other vegetation rustling dominated the noise environment in this otherwise quiet area. During still weather, the main noise source was bird song. Noise from diesel boat engines in the bay was significant occasionally.

The results show that the representative background sound level, L_{A90,15minutes} at this location was 36 dB during the day and 34 dB at night.

Excluding days where more than half of the measurements were discarded as a result of adverse weather, during the daytime, the period L_{Aeq} ranged between 40 dB and 45 dB and was normally close to 42 dB. During the night, the period L_{Aeq} ranged between 30 dB and 42 dB and was normally close to 35 dB. The period day and night values are shown in *Figure 1.38* and *Figure 1.39*.

Figure 1.38 Daytime Period L_{Aeq} Values

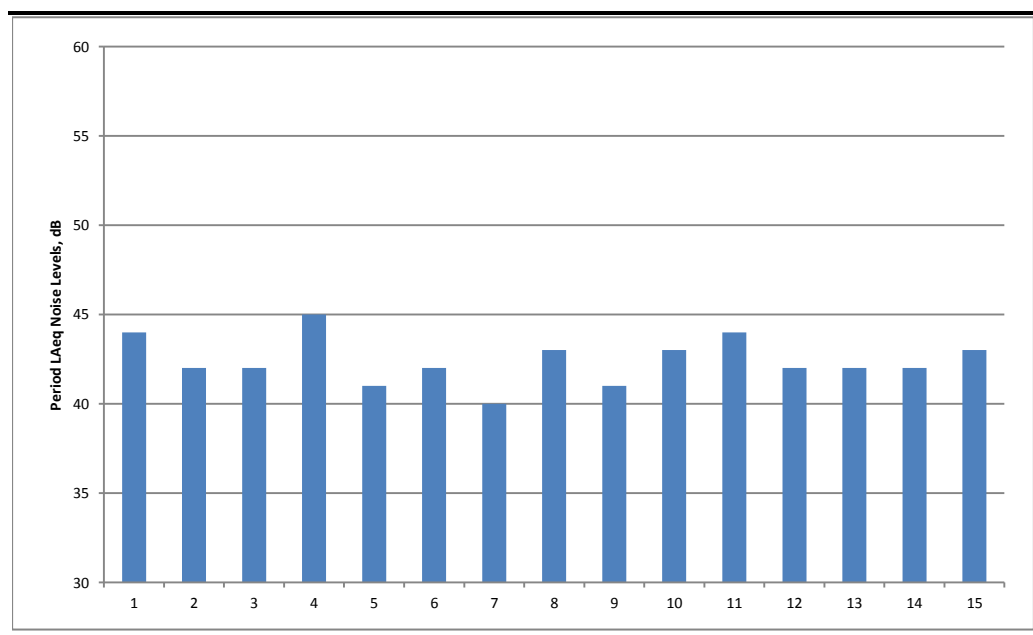
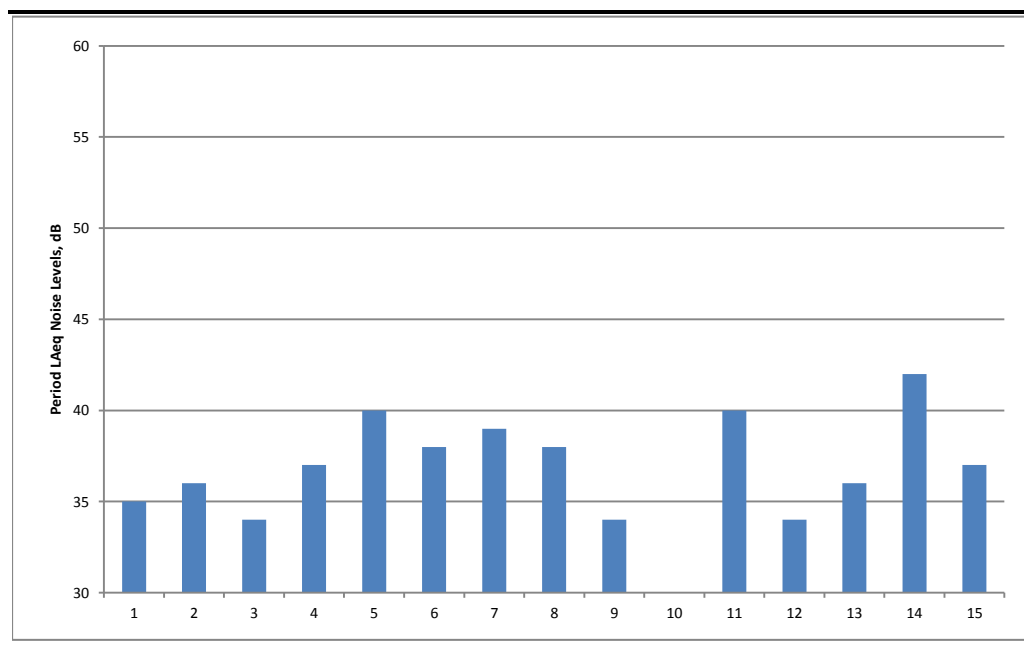


Figure 1.39 *Night-Time Period L_{Aeq} Values*



1.3.5 *Pembrokeshire Coast National Park*

An attended sound measurement was carried out for one hour on the Pembrokeshire Coast National Park footpath as it passes by the Refinery. During the measurement the weather was dry and the wind speed remained below 5 m/s. During the measurement period, the water in the bay was relatively calm, and the tide receded during the measurement so that the sounds of water could not be heard towards the end of the measurement period. The measurement result is provided in *Table 1.8*.

Table 1.8 *Attended Sound Level Measurement at the Coastal Path (Free-field)*

Date and Start Time	Duration	Measured Sound Level, dB(A)			
		L_{Aeq}	L_{A10}	L_{A90}	L_{Amax}
Thursday 2 nd March, 12.15 pm	1 hour	48	39	33	79

The noise environment on the path as it passes the Refinery is characterised by distant noise from the Refinery, the sound of water in the bay, occasional bird calls, occasional distant noise from a firing range approximately 1 km to the south and occasional cars passing along the path at low speed (at a distance of approximately 6 m at their closest point).

Annex B

Noise Modelling Input Data

1 OPERATIONAL NOISE MODELLING INPUT DATA

1.1 INTRODUCTION

Noise from the operation of the Project has been modelled for the purpose of supporting the planning application. The modelling is based on data provided by Valero. This Annex includes details of the noise model inputs.

1.2 MODELLING INPUTS

Table 1.1 provides a list of the all the equipment indicated as being potentially significant sources of noise and included in the noise model. All other equipment is assumed to produce noise levels that are not significant (either due to its nature or embedded mitigation). Not significant in this context means a noise level that does not contribute significantly to, ie is at least 20 dB(A) lower than, the overall predicted noise level from the Project at the nearest noise sensitive receptors.

The right hand column of Table 1.1 provides, for each item of equipment, details of the data and assumptions included in the noise model or refers to separate table of details.

Table 1.1 Potentially Noisy Equipment

Equipment	Details of the data and assumptions included in the noise model
Combustion Turbine Generator (CTG) package	See Table 1.2
Heat Recovery Steam Generator (HRSG) unit	See Table 1.3
Air blowing and Steam blowing	These activities are only required during commissioning. At all other times noise from these activities will not be significant ⁽¹⁾ .
1) Not significant in this context means a noise level that does not contribute significantly to, i.e. is at least 20 dB(A) lower than, the overall predicted noise level from the Project at the nearest noise sensitive receptors.	

Table 1.2 Typical Vendor Data CTG Package Noise Levels Included in the Noise Model

	Sound Power Noise Level, dB (linear)								Total, dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Turbine enclosure ⁽¹⁾	112	110	103	99	83	75	78	89	100

	Sound Power Noise Level, dB (linear)								Total, dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Gearbox and generator	103	116	100	89	84	81	75	64	102
Air intake	116	109	100	94	87	81	80	87	98
Exhaust duct	108	110	105	98	89	78	65	51	101
Filter house	118	106	89	79	69	64	68	74	94
Inlet Silencer	108	104	103	97	91	91	89	87	100
Inlet duct	112	108	107	101	95	95	93	91	104
Ventilation outlet duct	113	111	109	101	92	80	71	70	104
Ventilation outlet stack	123	108	98	94	95	89	91	102	105
Ventilation casing fan	100	96	96	93	93	91	79	74	97
Ventilation inlet duct	114	110	103	99	89	86	88	92	101
Air Coolers	110	107	103	100	96	90	89	87	102

Table 1.3 *Typical Vendor Data HRSG Unit Noise Levels Included in the Noise Model*

	Sound Power Noise Level, dB (linear)								Total, dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Transition Duct 1	102	80	59	48	39	29	30	25	76
Transition Duct 2	102	80	59	48	39	29	30	25	76
Superheater Duct	98	76	55	44	35	25	26	21	72
Evaporator Duct	96	84	57	42	32	21	21	15	72
SCR Spool Duct	94	82	55	39	28	16	15	8	70
Economizer Duct	87	75	48	30	18	3	6	0	63

	Sound Power Noise Level, dB (linear)								Total, dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Expansion Joint 3	69	60	44	31	19	3	13	8	47
Transition Duct 3	77	72	57	43	33	23	28	16	58
Breech	87	82	66	52	42	33	37	26	67
Silencer Duct	111	97	88	84	75	61	53	39	88
Expansion Joint 1	89	84	72	66	54	36	26	11	71
Elbow Duct	101	79	58	47	38	28	29	24	75
Expansion Joint 2	79	65	43	30	18	5	11	4	54
Stack	86	85	71	57	47	37	42	31	70
Stack exit (including 90° directivity correction)	98	100	88	77	71	65	61	54	86

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ERM's Swansea Office

Ethos
Kings Road
SA1 Swansea Waterfront
Swansea
SA1 8AS
T: +44 (0)1792306955

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